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A MODEL OF THE RELATIONSHIPS BETWEEN READING STRATEGIES AND READING COMPREHENSION

by

©

MONA JANE BEEBE

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
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ABSTRACT

The goal of this study was to formulate and estimate a model of the relationships between reading strategies and reading comprehension. The literature on reading strategies and reading comprehension is dominated by a psycholinguistic theory of reading. More recently, however, several researchers have suggested that reading is an abstractive-constructive procedure. Whereas the focus of much of the psycholinguistic approach has been on the identification of cueing strategies through the analysis of children's reading miscues, the focus of the abstractive-constructive approach has been on the identification of discourse processing strategies through the analysis of children's reading recalls.

Miscue analysis is well developed and well understood by many teachers of reading. Recall analysis on the other hand is still at the experimental or research stage. Thus, while it is correct to refer to a cueing strategy theory of reading, it may still be premature to refer to a discourse processing theory of reading. Nevertheless, the basic assumption in this study was that the cueing strategies posited by the cueing strategy theory and the discourse processing strategies posited by the discourse processing theory would be complementary strategies. That is, each set of strategies would be effective determinants of reading comprehension over-and-above the other set, other things being equal.

The study was structured into three levels or stages of analysis: a theoretical level, a measurement level, and a statistical level. Efforts were made to keep the levels isomorphic to each other, to facilitate the constant interplay between theory and research. The major problem in the study was the large number of measured variables in relation to the case base of 94 grade four pupils. Though there were only four cueing strategies, the rudimentary or embryonic state of discourse processing theory meant that the researcher had to examine two facets of discourse processing, the content of reading recalls and their structure, which together included twenty-nine variables. Thus, there were thirty-three independent variables which is far too many for model building purposes. Two methods of model simplification were used. Variables which were inadequately measured or which conveyed little information over those of other variables were dropped. The remaining variables were clustered into groups as determined by the theory, and those in each group were aggregated through the use of confirmatory factor analysis in the case of cueing strategy variables, and through exploratory factor analysis in the case of discourse processing variables. As a consequence of the application of these measurement techniques six composite variables were developed. There were two cueing strategies, the Grapho-Phonic and the Syntactic-Semantic; a Content of recall strategy; and three Structure of recall strategies, a Descriptive, an Associative, and an Integrative.

Four basic models were estimated using ordinary least squares regression procedures. On the basis of the estimates of the four basic models (a cueing strategy model, a content sub-model, a structure sub-model, and an integration of the cueing strategy and discourse processing models) three integrated models of reading comprehension were formulated and estimated. Decision-making at the model building stage was based on incremental model building techniques. These necessitated a second-order factor analysis in which the discourse processing strategies were finally identified as the Concatenation of information, the Association of information, and the Synthesis of information.

The results showed that the Syntactic-Semantic cueing strategy and the Synthesis of information discourse processing strategy had the greatest effects on reading comprehension. The final model clearly demonstrated that reading comprehension can best be explained in terms of an integrated model in which strategies suggested by both cueing strategy theory and discourse processing theory play important roles. The relevance of the research for pedagogical practice, and some suggestions for further research in modeling the process of reading comprehension were made in the conclusion to the study.

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CHAPTER I

INTRODUCTION TO THE STUDY

Statement of the Problem

Comprehension in reading involves the use of abstractive and constructive strategies. As a reader reads he abstracts or selects information from the text which he assimilates into his already existing repertoire of knowledge such that he is able to reconstruct or compose his own interpretation of the passage. Recently two schemes have been developed for examining how readers perform these operations; namely, miscue analysis and recall analysis. To date, no attempt has been made to investigate the similarities and differences of the two procedures nor to assess the compatibility of the theoretical underpinnings upon which the analyses are based. Such an undertaking was the major concern of this study.

Proponents of miscue analysis have developed a theory of reading based upon their understandings about reading and supported by the observations of what readers do as they read orally. The formulation of the theory gained impetus in the early 1960's when the well known Goodman-Goodman-Burke research team undertook studies involving the qualitative analysis of oral reading errors. At that point, it seems, the researchers intuitively believed that reading was a complex and integrated process rather than a simple precise process. They sought confirmation of their beliefs by carefully observing the behavior of children as they read orally, followed by the meticulous scrutinizing of each miscue that had occurred in order that they might understand the processes that readers used as they converted graphic print into oral language and meaning. The insights gained from their research culminated in a taxonomy of reading cues and miscues (Goodman, 1969) as well as a relatively cohesive theory of reading comprehension (1970).

Once they had confirmed the interplay of the three variables they had thought to be important to comprehension (letter-sound relationships, grammatical structure and contextual cues) the team attempted to have their theory substantiated by several doctoral candidates who were working with the Goodman group in the early 1970's. Such studies, like those of the Goodmans', were still descriptive in nature. However, during the late 1970's the theory was tested more rigorously by using larger data sets and inferential analytic techniques (Walker, 1975; Hood & Kendall, 1975; Beebe, 1980). As a result, a reasonably well developed theory of reading comprehension has been established whereby certain miscue phenomena are known to influence reading comprehension.

Recall analysis, on the other hand, is still at the exploratory stage and, as yet, the advocates of this procedure have not formulated a well defined theory of reading comprehension based upon their observations of readers' recalls of passages. Recall analysis procedures, then, do not have as strong a theoretical base as do miscue analysis procedures; rather, they are dependent upon the basic assumption that readers abstract information from print, relate it to their background knowledge and are then able to reconstruct a meaningful interpretation of the text. It should be kept in mind, however, that no theory is completely developed; that is, it is always possible to reformulate or modify the theory in order to make it more precise and explicit.

Work in the area of recall analysis surfaced somewhat later than the major thrust in miscue analysis. Kintsch and colleagues had a significant influence in the trend toward looking at what readers recalled, after reading a story, as a means of evaluating how the reader was processing or converting print to meaning (Kintsch & Keenan, 1973). Several other researchers have followed suit and have developed various schemes for assessing what it is that readers do as they interact with written discourse. To date, several categorical systems for analyzing the oral recall of stories have been devised but, as yet, no researcher has formulated an explicit theory of reading comprehension based upon the phenomena believed to underlie discourse processing. This is, in a large part, due to the fact that the phenomena underlying the processing have not been clearly identified. Rather, general postulates have been put forth in the form of an embryonic theory of discourse processing.

Kintsch and van Dijk (1978) have probably been the most explicit in specifying the mental operations that underlie the processing of text and the subsequent production of a recall of a text. They claim that three sets of operations are involved.

> First, the meaning elements of a text become organized into a coherent whole, a process that results in multiple processing of some elements and, hence, in differential retention. A second set of operations condenses the full meaning of the text into its gist. These processes are complemented by a third set of operations that generate new texts from the memorial consequences of the comprehension processes. (p.363)

In order to perform these operations, Kintsch and van Dijk have found that readers transform, reproduce and reconstruct text information during reading and during recall.

It is, of course, recognized by the present researcher that such rudimentary or underdeveloped theory serves a vital purpose in that it identifies the essential assumptions on which research can be based and, therefore, provides a starting point in theory development. As research findings delineate the phenomena underlying the embryonic theory, the theory can be revised, elaborated and clarified into a more explicit and comprehensive statement of the relationships between the factors affecting reading comprehension.

At this point in time it would be premature to regard the basic assumption that readers abstract, integrate and reconstruct information during reading as a well developed theory of reading comprehension. However, in the interests of parsimony, the embryonic theory underlying recall analysis will be referred to as a theory, but bearing in mind that it is only an implied theory rather than an explicit theory. The theory underlying miscue analysis is, hereafter, referred to as cue selection or cueing theory and the theory underlying recall analysis is called discourse processing theory. The two methods have many similarities and some differences. Likewise, the theories underlying the analyses have much common ground but each also has some unique aspects. A brief overview of the underlying theories will set the stage for the current study.

Cue Selection Theory

As early as 1908 Huey indicated that "We have surely come to the place where we need to know just what a child normally does when he reads, in order to plan a natural and economic method of learning to read (p.9)". Huey's insight into the need to understand what a child does when he reads served as a turning point in the way educators began to think about reading later in the century. Thorndike (1917), like his contemporary Huey, was a notable exception among early investigators when he generated the interrelated and complex concept of reading that has formed the basis of much of the research and theorizing during the latter part of this century. In his well known paper "Reading as reasoning: A study of mistakes in paragraph reading," Thorndike pointed out that:

> Reading is a very elaborate procedure, involving a weighing of each of many elements in a sentence, their organization in the proper relations one to another, the selection of certain of their connotations and the rejection of others, and the cooperation of many forces to determine final responses. (1917:323).

Continuing with his description of the complexity, Thorndike emphasized that:

> The mind is assailed as it were by every word in the paragraph. It must select, repress, soften, emphasize, correlate and organize. (p.329)

Since that time a great deal of interest has been focused on attempting to identify the mental processes that readers use. During the 1950's and 1960's considerable emphasis was placed on factor analytic techniques designed to identify the postulated dimensions of reading comprehension which were thought to reflect the processes underlying the ability to comprehend (see Harris 1948; Holmes & Singer 1964; Davis 1964; and Spearritt 1972). Also working at that time was Carroll (1964) who suggested that a fruitful theoretical analysis of reading must not rely solely on psychological understandings of the mental processes but must concern itself with other relevant disciplines. One such discipline that has made a notable contribution to an understanding of the reading process is linguistics (see Bloomfield & Barnhart 1961; Fries 1962; Lefevre 1964; Wardaugh 1969; and Chomsky 1957). In the late 1960's and early 1970's Kenneth and Yetta Goodman attempted to synthesize the ideas of psychologists and linguists into a psycholinguistic theory of reading based upon their observations and evaluations of the errors that children made while reading aloud. The scheme devised by the Goodmans allowed investigators, through the qualitative analysis of oral reading errors, to observe the strategies readers were using.

The theory underlying miscue analysis posits that reading behavior involves more than simply the identification of words and letters in a precise and sequential manner. Rather, it is claimed, reading involves the processing of all types of information that are available to the reader as he attempts to construct meaning from printed material. This information includes: (a) the configuration of letters in a line of print, sentence, or paragraph; (b) the syntactic, or grammatical cues inherent in that line, sentence or paragraph; (c) the semantic, or meaning cues associated with the reading material; and (d) the interrelationships among (a), (b) and (c) with the reader's repertoire of prior knowledge, including knowledge about language. The way in which the reader selects and balances these cues during reading is referred to as the use of cue selection or cueing strategies.

The claim, then, is that the ability to understand print depends as much on what the reader brings to the reading situation as it does upon the graphics presented on the page. This notion of the importance of a reader's already acquired syntactic and semantic abilities interacting with school-learned graphic and phonic abilities to produce comprehension during reading, seems to have heralded a whole new era of interest in the study of prose comprehension despite the many problems inherent in the measurement of comprehending ability.

This willingness to investigate reading comprehension despite its imprecision, may be due to at least two factors. First, many investigators have lost faith in the idea that carefully controlled laboratory-type experiments are generalizable to the natural classroom setting (Kish, 1975). Second, and perhaps more important, is the fact that it is now easier to conduct research and develop theories related to reading than it was ten years ago, due to the developments in both computer processing capabilities and linguistics.

Perhaps the most important contribution of the computer, for this study at least, is the fact that it can carry out the necessary calculations for estimating the structural parameters of measurement models which have been designed to be isomorphic with the theory. That is, once a theory has been constructed and techniques designed to measure the underlying theoretical constructs, a statistical model composed of sets of equations isomorphic to the measurement model can be selected for estimation purposes. (See the section on model building which follows).

Discourse Processing Theory

Another reason that theorists have turned to prose processing is the concomitant development of text grammars (Mandler and Johnson, 1977; and Thorndyke, 1977) which allow a researcher to analyze a piece of prose into its constituent parts. It seems that stories exhibit conventional patterns of organization; the main protagonist is introduced, he acquires a goal and attempts to achieve it. Van Dijk in several studies (Kintsch and van Dijk, 1978; van Dijk, 1977; and van Dijk and Kintsch, 1977) also found that when subjects were asked to read and summarize or read and recall passages there was a great deal of consistency in what was recalled and what was included in a summary. The common propositions, or units of information, found in the recalls formed a short story and were very similar to the content of summaries. These consistently recalled propositions he called the macro-structures of the story and, in effect, they formed a global reconstruction of the passage that was read. The propositions constituting such a macro-structure tended to deal with the introduction of the main character, the character's goals, the actions leading to the goals and the results from the attempts. Propositions concerned with settings, mental actions and other details tended to be ignored.

From investigations such as these, it has been claimed that readers remember the gist or global interpretation of a story because of the background knowledge they have of what constitutes a story. In other words, because of prior experiences within a reader's life, he is able to bring a familiarity with "stories" to the current reading situation which allows him to interact with the print or graphics in such a way that he is able to organize and relate together the complex episodes that intertwine as the story unfolds.

Research on continuous discourse comprehension actually dates back to the work of Bartlett (1932) who put forth the view that readers construct meaning while reading and then remember what they have read via an active process of reconstruction of information in which the present knowledge system of the reader forms a framework that interacts with the new information coming from the text. Later, Gomulicki (1956), Gauld and Stephenson (1967) and Zangwill (1972) suggested that an abstractive process is involved during comprehension and recall; that is, non-essential information within a text is eliminated so that the gist of the text falls within the scope of being able to be recalled.

Tierney, Bridge and Cera (1978) claim that continuous discourse processing operations involve both constructive and abstractive processes. Based on a study of grade three children, they found that readers seemed to utilize abstractive processing whereby they attempted to: (1) "glean what might be considered relevant units from the text; and (2) summarize the ideas into a manageable form in accordance with what can be handled by the memory system (p. 552)". At the same time, they claim, readers are constructing comprehension by "using information from the text in association with their background of knowledge. . .(p. 554)". In order to achieve a meaningful interpretation of print, readers make transformations of the text which involve simplifications (omissions), consolidations (additions) and sometimes retransformations (substitutions).

Readers, it seems, selectively process text using information both from the text and from their knowledge of the world as they construct an interpretation based upon the integration of the two sources of information. Such a view of what readers are doing as they comprehend is clearly in the forefront of current reading theories. Recall analysis, or the analysis of the recalls that readers give after reading a story, was introduced as a viable means of looking at the processing strategies that readers use during silent reading. Miscue analysis, as pointed out above, used as its data base oral reading errors. This procedure was based on the assumption that the miscues were representative of the underlying mental and language processes utilized during oral as well as during silent reading. Many researchers, however, were unhappy with such an assumption and have, therefore, devised a new procedure for investigating the strategies of silent readers. In addition, many researchers were dissatisfied with the sentence level analysis put forth by Chomsky (1957) and by miscue advocates (since miscue analysis is conducted mainly at a sentence level). Instead, they wanted the analysis to be based on the continuous recall of connected discourse; hence, the term discourse processing theory.

Purposes of the Study

It would appear that the cue selection theory of reading comprehension put forth by the Goodmans in the mid 1960's and the discourse processing theory suggested by advocates of recall analysis (see van Dijk, 1977; Frederiksen, 1977; Kintsch and van Dijk, 1978; and Tierney et al., 1978) are both based on the concept of the abstractive/constructive processing that occurs as readers attempt to integrate their life and language experiences with the graphics of the text. The purposes of this study, then, were twofold: (1) to clarify the theory underlying recall analysis; and (2) to integrate the two theories of reading comprehension. This task required, first of all, the formulation and specification of the cue selection theory followed by the formulation and specification of a cohesive discourse processing theory. The formulation and specification of the relationships between the two theories then had to be considered. In order to estimate the complementary nature of these two theories, an integrated model elucidating the theories was tested by estimating the magnitude and evaluating the significance of the parameters of the cue selection theory while taking into account the theory of discourse processing and vice versa. In this way, a model of the relationships between reading strategies and reading comprehension was formulated and estimated.

Significance of the Study

During the 1960's, a large number of reading models were formulated. Many of these models tended to deal with the organization of skills and abilities (Gray, 1960; Robinson, 1966) or with the processes of reading based on a psycholinguistic theory (Goodman, 1966; Ruddell, 1969). Some models dealt with specific parts of the reading process (see Gibson et al. 1962 on perception; Singer 1966, on cognition) or with the interaction between physiological and cognitive processes (see Davis, 1964). Still others formulated models that were intended to be comprehensive (see McCullough, 1968; Spache, 1963; Strang, 1965). While many of these models may have been based upon some empirical data, few have been empirically or statistically tested. Perhaps the most common reason for this lack of rigorous evaluation has been the fact that many of the parameters of the models have been unmeasureable and/or inadequately defined. Further, most of the models have been presented as extremely complex entities with numerous feedback loops which until recently defied estimation. The best, then, that these models could do was to present a theoretical position on what seemed to be happening during reading comprehension.

Two trends in research seemed to emerge during this era:

(1) a trend toward research in reading that focused on the explanation of reading phenomena in smaller and smaller units; and (2) a trend toward the construction of theoretical models to represent the processes of reading in a causal chain of events (Holmes and Singer, 1964). Researchers began to use the theoretical models as a guide for determining what variables and relationships needed to be studied in greater detail. They could then hypothesize where the smaller units of the investigation fitted into the overall theoretical structure with the result that the theoretical model could be modified if need be. Such closely interdependent and mutually directed theory construction is, of course, the ideal relationship between a theoretical model and research. But "essential for the attainment of this ideal relationship," as Singer (1970, p. 151) points out "is the formulation of a theory on which the model is based in such a way that testable hypotheses can be derived from it." This, in many instances, had not been done, even by the late 1970's.

Singer in a later article (1976) was still lamenting the fact that many models in reading were not being empirically tested. Models he claimed:

> ...need to be put to empirical and statistical tests to determine whether they can explain and predict reading behavior. Evidence from statistically determined models of reading and from a cursory review of development of language, cognition, and reading suggest that a series of models is necessary to account for quantitative and qualitative changes in systems and subsystems associated with improvements in reading achievements as individuals progress through school. Also, the models will, of course, have to be updated as new concepts are formulated.(p. 650)
>
> Through such a means it would be possible to determine empirically the heuristic and explanatory value of models that are currently being used explicitly or implicitly in teaching and in research. (p. 651)

As yet, there seems to be a lack of studies concentrating on incorporating new concepts into already existing theories in such a way that the up-dated models can be tested and evaluated. It is for this reason that the present study may have theoretical and practical significance. If significant relationships between the parameters of the discourse processing theory and reading comprehension still exist while taking into account the effects of cue selection strategies, then a complementary relationship between the two theories will have been established. This, in effect, would mean that the predictors of both theories contribute toward reading comprehension and that the ability to analyze and synthesize the incoming information of connected discourse accounts for reading competency over-and-above the strategies that children use to select cues from their background knowledge and from the printed page in order to comprehend. It is important to know that if teachers can develop an ability within readers to relate sentences and parts of sentences to one another within passages that comprehension will likely increase more than if teachers simply concentrate on attempting to develop an awareness that print must sound right and must make sense a sentence at a time.

Further, by empirically estimating an integrated theories model, one can evaluate the relationships between the parameters of each model such that it may be possible to predict that if a parameter in theory one is increased it will likely produce a concomitant increase in another parameter of theory two. For example, do children who tend to read exactly and precisely, that is, who are high in the use of grapho-phonic skills, give recalls that indicate they have tried to memorize verbatim from the text rather than reconstructing the story in their own words? If so, this indicates to teachers the dangers involved in a reading program that always demands a precise, accurate pronunciation of each word. Perhaps such an approach is giving that child a false impression of what reading is all about.

Theory and Model Building

A theory is a verbal statement of what are believed to be the relationships of phenomena underlying some behavior. How does a young child learn to read? What happens in the mind of the student during the comprehension of printed material? Answers to questions such as these take the form of theoretical statements, which require analysis of unobservable, internal thought processes (Calfee and Drum, 1978). The analysis begins when the researcher gathers together, from whatever knowledge is available and from practical experience, a set of ideas that tentatively suggests or hypothesizes the actions and interactions that are working together to produce the behavior. A theory, then, attempts to account for what it is that allows or prompts the behavior in question.

The word "model" has been used or misused to describe virtually any attempt to specify a system of behavior that is to be studied. A model has often meant the physical replica of a system; for example, an aircraft designer constructs a model so as to study its behavior in a wind tunnel. In the reading literature the term model seems to be used in a variety of vague and ambiguous ways. Some researchers are adamant that theories and models constitute two distinct domains (Pearson, 1978; Kingston, 1970). Theories are usually defined as descriptions of a set of relationships. To date, however, the present researcher has yet to find a clear statement of what constitutes a model. Models are talked about, as Singer and Ruddell (1976) exemplify in their "Introduction to Models" section of the second edition of Theoretical Models and Processes of Reading, but they are not defined. The closest thing to a definition occurs in Venezky, Massaro and Weber (1976) when they describe what a good model should do.

> A good model is one which organizes complex and seemingly unrelated data in an interesting manner, and which generates testable hypotheses. In this sense, a good model for reading process is one that reveals its limitations in a hurry; that is, it leads to experiments which themselves produce data for building an improved model. (p. 690)

To some people the word model suggests an attempt to construct a microcosm of the system under study in the sense that the model will mimic or represent the behavior of its macro-counterpart. This is one kind of misconception that seems to have occurred over and over again in reading models (Venezky et al., 1976). Almost every aspect of reading behavior has tried to be incorporated into one global, comprehensive rendition of reading ability. Behavior systems are far too complicated to permit such ambitious undertakings. Models are built for specific purposes so that what is included in a model depends largely on the decisions which it will help the researcher, analyst, or practitioner to make. That is, there are different models for the same system, as is evident in reading, and which model is used will depend on the purpose of the model. For example, a model of early reading for the purpose of planning a remedial reading program would be quite different from a model of early reading for planning a classroom library.

Sometimes a model is depicted as a diagram with an elaborate and extensive explanation of the reading behavior the diagram is attempting to capture (Gough, 1976; Ruddell, 1969). Sometimes, as well, models seem to be thought of as the statement of sets of operations (a theory really) which is then tested on empirical data (Kintsch and van Dijk, 1978). Still, at other times a model seems to be describing either a study complete with its underlying theory (LeBerge and Samuels, 1976) or a study which is simply a "take off" or an extension of other studies (Anderson, Goldberg and Hidde, 1976). There seems to be no clear consensus in the reading field as to what constitutes a model and how it differs from a theory. Since this study is concerned with the formulation and estimation of a model of the relationships between reading strategies and reading comprehension, it would seem essential first, to describe what the present researcher perceived a model to be, and second, to demonstrate the sequence of steps involved in building a model of reading comprehension.

In this study, a model refers to the specification of the interrelationships of the parts of a system. Usually the specification of model relationships is made in verbal and diagrammatic terms, and/or mathematical terms. A verbal model is proposition-like and is usually referred to as the theory, whereas a mathematical model is a system of equations formulated such that the equations represent the set of propositional relationships. Model building, then, is nothing more than the method of scientific inquiry; that is, a process of matching theory to empirical evidence. The model building strategy is referred to as an incremental modeling approach (cf. Duncan, Featherman and Duncan, 1972). Its application in education is exemplified in a monograph by Clifton (1978).

Model building usually starts with the formulation and estimation of simple and modest models. Work toward more complicated systems is done by integration; that is, by extension and elaboration. Yet, the necessary oversimplification in the formulation of basic models may result in the failure to capture the system adequately, and important features are consequently left out. The question then becomes not whether the model is adequate for all purposes but whether what has been omitted in the simplified model is relevant and necessary to the purposes for which the model was constructed.

Models, then, are often criticized for not being "realistic", especially when human behaviors have been summed up in a set of mathematical equations. Such criticism misses the point. Models are "unreal" by definition since their purpose is not to mirror reality but rather to reduce the features of that reality to a more manageable form for the purposes of prediction and control (Ball, 1968, p. 18).

Some Characteristics of Models

Models are used in a variety of areas and for a variety of purposes. For example, sociologists model the socioeconomic career or the course of one's career; economists use models to forecast economic changes; and meteorologists use models to predict the weather. Even though the content of these models is different there appears to be a common logic in all of them. All models have characteristics in common which can best be expressed as dichotomies.

Theories versus mathematical models. The two basic ingredients of any model are theory and facts; and modeling involves the combining of these ingredients. However, considerable bodies of literature in every behavioral discipline emphasize one ingredient to the virtual exclusion of the other. Thus, "theory only" schools are concerned with formulating theories that are often untested or untestable. The "facts only" school on the other hand is concerned with developing, collecting, measuring and improving data. A "facts only" example from education would be the collection of macro-data such as the between-Province, or between school differences on the Canadian Tests of Basic Skills. Undergraduate text books in education are usually representative of the "theory only" school.

Either of these extreme approaches is difficult to defend. Theory has little empirical content and in any case rival theories can all too easily be developed. The only way to choose between them is on the basis of evidence in the form of facts. As for "facts only", it is true that facts seldom speak for themselves. To be useful, facts normally have to be interpreted in terms of the relationships postulated by a theory.

But theory together with relevant facts is still not enough. After the theory has been formulated and the facts organized into a set of data, the two basic ingredients have to be combined for purposes of estimation. Estimating methods are usually based on the methods of mathematical statistics, especially the branch of statistics known as statistical inference. Thus, modeling is not merely a matter of combining fact and theory. The combination has to be expressible in a falsifiable manner in order that the parameters of the postulated relationships can be estimated. Mathematical models, then, are concerned with statistical estimation of the relationships among the facts as formulated by the theory.

Models are composed of these three interrelated components or analytical levels, each of which in the ideal case will be isomorphic with the others (though perfect isomorphism is impossible). These levels include the theoretical level, the measurement level and the estimation level. The first is called the theoretical model or the theory; the second, the measurement or auxiliary model; and the third, the statistical or mathematical model (cf. Intriligator, 1978, chapter 1).

Deterministic versus probabilistic models. Sometimes mathematical equations may be formulated which express the behavior of a system in purely deterministic terms, though this is rarely the case in behaviors associated with human beings. Almost invariably in education, probabilistic elements will have to be included in the equation. This, in effect, means that unknown or unmeasured predictors of the behavior in question are operating to produce the behavior in addition to those elements which have been identified. Often these unknown entities are called residuals (what's left over), error terms, or disturbance terms. The best that can be achieved in formulating models of human behaviors is the construction of probabilistic models.

Simulation versus solvable models. For most systems of behavior that are relatively simple, it is possible to solve the set of equations constituting the mathematical model that are analogous to the measurement model and the theory. Thus, the behavior of the system can be expressed in general formulae. This, of course, is the ideal. Often the equations in the mathematical model can be written down but, for various reasons, are unsolvable. There may be too many unknowns or the theory may be so complex that an isomorphic mathematical analogue cannot be developed. In these situations it is sometimes possible to simulate the behavior of the system under a range of different conditions; that is, to give one specified relationship a value and then see how other relationships operate in conjunction with it.

More frequently, though, so-called models are formulated which are unsolvable because the concepts or phenomena of the model are unmeasureable, or so varied or different that an acceptable metric common to each concept or case cannot be devised. These unsolvable models are sometimes referred to as qualitative models because of their subjectivity. In recent years, however, non-observable concepts have been incorporated into models of behavior systems by constructing variables that act as proxies for the variables in question. The usual way of doing this is to use factor analytic techniques to devise a proxy variable from several indicators that are believed to be representative of that behavior and that are measureable. A good example is the IQ test which is based on a series of subtests that are believed to measure the properties of intelligence which, itself, is unobservable. In this way, even if a concept cannot be measured directly it might be possible to construct a variable representative of the concept for inclusion in a set of mathematical equations.

Descriptive versus analytic models. Some models attempt only to set up simple linear relationships of the stimulus-response variety without attempting to explain the reasons for the relationship. For example, in order to test the relationships between fertilizer use and crop yield only the application of a stimuli (fertilizer) followed by observation of the response (crop yield) is necessary. Any inquiry into the chemical mechanism connecting the two is absent. Similarily, testing the relationship between language usage and reading comprehension only requires studying the input (language usage)/output (reading comprehension) relations without enquiring as to why the relationship exists at all.

In effect a "black box" situation exists. Input-output or stimulus-response relationships are studied with no attempt to look inside the box to find out how things work. Such studies are essentially descriptive because they describe what is rather than why it is so. When the researcher wishes to know how the system would work if some of its determinant relationships inside the box were discovered and/or changed, then the study may be called analytic or explanatory (see Kendall, 1968, p.4).

Yet all models are to a degree analytic. The distinction between description and explanation is one of degree, rather than of kind. For example, consider the strong relationship that exists between reading and numeracy in the early grades. Early models of this relationship were considered analytical enough if it could be shown that changes in reading comprehension were associated with concomitant changes in arithmetic performance. More recently, however, efforts have been made to account for the covariation between reading and numeracy by identifying their common causes. Further, efforts have been made through the use of advanced statistical techniques to measure the responsiveness of reading and numeracy to these common causes; that is, to look inside the black box both out of curiosity as well as out of practical concern. In practical terms the question becomes, "How does the reading-numeracy system behave if its determinant relationships are changed?"

Perhaps the best way to look at the descriptive-analytic distinction is to regard model building as a continuing attempt to become increasingly analytic. Basic models then may be both simple and descriptive, but as extensions and elaborations to the basic relationships are made in order to investigate further the complexities of the model's relationships, the models are likely to become increasingly analytic.

Experimental versus nonexperimental models. The earliest statistical models were designed to analyze the data of controlled experiments. These typically involved very few variables since potential problems from outside influences were controlled through randonization. Educators, however, are often faced with the impossibility of experimentation. Whilst it is true that we can experiment to some extent, for example a new approach to teaching reading can be set up so that the results for the experimental classroom can be compared to those where the approach is not used, not all problems that researchers wish to investigate can be structured to fit the experimental model. Confounded with this problem is the fact that experimental subjects are rarely representative of the population of substantive research interest. This means that very often the preferred reality of the natural setting is lost when the research design is of the experimental variety (Kish, 1975).

Models which are based on nonexperimental designs can, nevertheless, be used for experimentation. Consider, for example, a model of reading comprehension. Is the process of comprehension in reading the same for boys as for girls; for field dependent as for field independent students? By comparing the parameter estimates of the reading model for a sample of boys to those for a sample of girls, whether the process is the same or not, or if not, in what respects it differs, can be evaluated both quantitatively and with confidence. A model can be examined, or models can be compared, under a whole range of such different conditions -- different class sizes, strict discipline versus conditional freedom and so on. It is anticipated that nonexperimental multi-causal models will increasingly become both the subject and instrument of experimentation in future model building research.

Macro versus micro-models. The model dealing with the behavior of individuals; that is, where individuals are the units of analysis, is the micro-model. If the unit of analysis is the classroom or the school, where the analysis characterizes the interaction among aggregates of individuals, the model is a macro-model.

Reciprocal versus recursive models. Recursive systems are models in which the flow of effect is one way. Typically they are known as chain models in which what happens at one point in time influences what happens at the next point in time and so on. That is, each variable is dependent on those preceeding it in the model but not on the other variables at the same point in time.

Reciprocal systems, or interdependent feedback models, are much more complex than recursive models. Hence, the procedures for estimating recursive models are not transferable to the estimation of reciprocal models. This is largely because the assumptions underlying the statistic used in the analysis of the recursive model are violated by the reciprocal model.

Another problem attendant upon the estimation of reciprocal or feedback relationships concerns model stability. If variable X and variable Y affect each other in a reciprocal manner, what happens to the stability of the model? That is, if an increase in X, as a result of some external agent, produces an increase (or decrease) in Y, which in turn reciprocally produces a change (increase or decrease) in X, what is to prevent this from continuing to occur indefinitely? Such reciprocal effects are common place in micro-level analyses where individuals are the focus of interest. Reciprocal relationships of this nature are often postulated in theories of school learning but are seldom estimated because feedback model analysis is less well known and understood than the analysis necessary for estimating recursive models.

In order to handle this kind of problem, one needs a reciprocal dynamic model that involves a time element. Time dimensions within a behavior system have to be specified and these are then incorporated into the measurement model so that reciprocal model analytic techniques can be used.

To shift from the analysis of recursive models to the analysis of reciprocal models involves a major change in the way in which model building activity is conducted. As the number of feedback loops and time dimensions or sequenced variables increases, the complexity of the model increases multiplicatively. And as the complexity changes so does the scope since the researcher gains awareness of the strategies for extending and elaborating models.

Confounded with these problems of scope and complexity in developing reciprocal models is the problem of estimating the relationships specified. The greater the number of feedback loops in a model, the greater the problem of multicollinearity or overlap in what the different variables are attempting to measure; hence, the necessity of formulating appropriate methods for the estimation of reciprocal models. The application of such analytic skills is well beyond the scope of this study. Consequently, a less complex model will be formulated and an analysis appropriate to a recursive model will be conducted. It should be pointed out, however, that a logical next step in reading research might well be the testing of feedback models of reading.

Low information versus high information models. In much educational research the models formulated are often of a very complex nature. Unfortunately, this is often coupled with very little in the way of background information or prior knowledge about a postulated model. This situation is in contrast to the modeling paradigm in the physical sciences where the experimental models are relatively simple and where there is usually a whole tradition and body of knowledge that has been built up over the years to the point where assumptions, procedures, hypotheses and background information on the study are well established (Wold, 1968, p. 145). These differences in model building between the physical and social sciences has come to be expressed as "soft" and "hard" modeling (Wold, 1978). The soft-hard distinction corresponds closely to the nonexperimental (soft) and experimental (hard) modeling discussed earlier. When, however, models in learning behavior (or any other area of the social sciences) are formulated on the basis of abundant prior knowledge on the topic, tested hypotheses, and basic assumptions in the field, it is possible even for nonexperimental models to be of a mixed nature; that is, both complex and high informational.

Dynamic versus static models. Models can be either static or dynamic. If there is no built-in dependence on time in the model; that is, if a time factor is not a key component or element in the model, the model is of the static variety. Survey research that is conducted at one point in time is of this nature. Or, if the data are collected at two points in time but the elements of the study are not dependent upon changes in magnitude over time, then the model on which the study is based is said to be static.

On the other hand, when the outcome variable in the study is clearly dependent upon the increase or decrease in magnitude of that variable from a previous point in time, then the model is dynamic. A good example of a dynamic model is one in which a pretest is given, a period of time elapses, and a posttest is given. The interest in such a model is focused on the amount of growth, improvement, or achievement gain that has occurred during the time lapse, and hence, the term "dynamic" to represent the ongoing nature of the variable under question. The emphasis in a dynamic model is clearly on the differences in variables over time. Longitudinal studies would also fall under this category.

Characteristics of the Formulated Model

The model of reading comprehension formulated in this study had the following characteristics.

1. The study was structured into three analytical components; namely, the theory level, the measurement level, and the statistical level.
2. It was probabilistic in nature because it was not possible to control all influences on comprehension and, therefore, other unknown factors affected the outcome variable.
3. The variables representing the underlying constructs or phenomena of comprehension were measurable and the equations depicting the relationships of the phenomena were solvable. Therefore, the model was both computable and solvable.
4. The model was predominantly explanatory or analytic since the purpose in constructing the model was to explain reading comprehension.
5. The study was nonexperimental in nature in the sense that it was a survey of what these particular readers were doing at a given point in time.
6. Since the individuals in the study were the unit of analysis, it was a micro-model.
7. The model was of the recursive variety; that is, the flow or direction of the predictor variables was in one direction.
8. The model had relatively high complexity because it emerged as an elaborated model from the integration of two basic models. Further, it had relatively high information since considerable background work has been done in the underlying constructs for

each basic model.

9. Since increase in achievement over time was not a factor in the study, the model was considered to be static in nature.

Limitations of the Study

There are three main areas where limitations occurred in this study; (1) limitations in model building; (2) limitations in the measurement of variables; and (3) limitations in data gathering. The first area, limitations in model building is characterized by three problems that plague much of the research in learning behavior. First, there is the matter of fit between the analytical levels. As explained above, models are composed of three analytical levels; namely, theoretical, measurement, and statistical. In the ideal case, there will be complete isomorphism, or a perfect fit between the structures of each level. This means that each level is an exact representation of the preceeding level. But such an attainment is impossible, hence, model isomorphism is always a matter of degree. A major limitation of any model building project, including the one for this study, is the lack of fit between levels. The best a researcher can do is to produce the best fit possible given the constraints in the research design.

The second problem in the model building area concerns the absence of experimentation within the nonexperimental model. Since the purpose of the study was to integrate two theories of reading comprehension into a more comprehensive model of reading, the formulated model itself was not used for experimental purposes. For example, it would be useful to examine whether or not the reading process, as delineated in the model, is the same for boys as for girls. Likewise, it would be useful to see whether or not the model parameters are affected by such different learning environments as open versus traditional classrooms. However, the size of the sample and the absence of learning environment data precluded this kind of experimentation.

The third problem in this area arose from the fact that dynamic features and reciprocal causation factors were absent. There is little doubt that the reading process is dynamic in nature and that it is characterized by a system of reciprocal or feedback effects. It is not prudent, however, to consider these more complex models before having investigated the properties of basic and less complex models. In any case, the estimation of dynamic models with reciprocal features is well beyond the scope of most investigators working on their own. It is more of a problem for small groups of interdisciplinary model builders.

The second area of limitations, measurement of variables, has two aspects. The first concerns how well the reader's verbal recall of the reading passage mirrored what he understood as he read. Two problems were foreseen. Some children may have understood, at the time of reading, more than they were able to recall and transmit to the investigator immediately following the reading of the passage. Problems of this kind may be due to reticence and inhibition in a research situation, especially where the subjects have had little prior contact with the investigator.

On the other hand, it was also anticipated that some children may have, in fact, given more information during the recall situation than they understood at the time of reading. It is believed by some reading experts that children may perceive relationships intended in the print as they are retelling the story rather than when they are reading the story. The idea is that as the reader begins to weave the story together for the listener/investigator, "clicks of comprehension" may occur and be verbalized that were absent during the actual reading. Even if this is the case it should still count as comprehension of the passage since, had the reader not retold but thought about the story immediately after reading it, it is likely that the "click" would have occurred regardless of the retelling.

The second aspect of the measurement limitations has to do with the psychometric properties of the variables and the scales used to measure the retelling of the story. In many respects the model formulated was based on a good deal of prior knowledge and was, therefore, considered to be a high information model. Yet, few attempts to construct variables and scales for the analysis of the recalls of the stories have been successful. Thus, the psychometric properties of these variables were largely unknown and the way in which the variables were constructed for the purposes of testing this segment of the model were formulated for the first time. Similarly, some of the hypotheses and assumptions underlying the study were formulated for the first time, though they would seem to follow logically from the writings of the theoreticians in this field.

The data gathering limitation had four aspects. First, the sample was not randomly selected. This suggests that the findings cannot be generalized to a wider population. Second, after two schools had been selected all students within the selected grade level were given a pretest to delimit the range of reading ability within the sample. Only those students scoring seventy percent or above on the pretest were included in the sample. The case base, then, was biased in that only "good" readers or readers reading close to or above their grade level were included. Third, each subject read only one passage. This procedure may have been a limitation because the scores obtained for each child, on the basis of a single trial, may not have been a true reflection of reading ability. Fourth, the sample size was relatively small. Although ninety-four students constituted the case base, if the number of possible independent variables within the model were used it would have prohibited a stable analysis. Consequently, variables in the form of factors or scales were constructed as a data reduction technique to assist in dealing with this problem.

CHAPTER II

THEORETICAL BACKGROUND TO THE STUDY

As pointed out in Chapter I, readers use various strategies in order to abstract information and construct meaning during reading. The purpose of this chapter is, first, to present the theoretical underpinnings of the cue selection strategies and the discourse processing strategies used by readers as they comprehend. Once the relevant theoretical background pertaining to each set of strategies is discussed, the similarities and differences between the theories are highlighted. Finally, a method of evaluating whether or not these differences/similarities render the theories competing or complementary is suggested.

Cue Selection Strategies and Reading Comprehension

Comprehension in reading involves using a set of procedures that allows the reader to select from his personal experience and knowledge about the world, those concepts or ideas that are relevant to the text at hand. That is, comprehending "entails an interaction between an incoming linguistic message and the comprehender's world knowledge", a process referred to by Royer and Cunningham (1978, p.3) as the "minimal principle" of reading comprehension. The "minimal principle" can take a weak or a strong form. The weak aspect refers to the fact that the reader's prior knowledge plays a part in the perceptual processes of reading which include identifying characteristic features in letters, letter-sound relationships, spelling patterns, as well as words and word meanings. For the most part, then, the weak aspect of the principle refers to relating visual perceptions to word meanings. The strong form of the "minimal principle" maintains that such letter and word identification processes "merely set the stage" for comprehension and beyond that there is another sort of interaction between linguistic input and prior knowledge which operates on units larger than words and which is responsible for the "click of comprehension".

During the 1960's and 1970's a growing number of reading theorists paid particular attention to the use that a reader must make of prior knowledge which is relevant to the material to be read (Goodman, 1969, 1970; Hochberg, 1970; Kolers, 1970; and Smith, 1971, 1973, 1975). This utilization of prior knowledge has frequently been referred to as "hypothesis testing" or "predicting" and is now believed to constitute a key ingredient to successful comprehension. As such, it is claimed by Goodman (1976) that the ability to predict involves using all types of information available to the reader as he attempts to extract meaning from printed materials. This information includes the graphic and associated phonic, the syntactic and the semantic cues inherent in the reading materials and the interaction of these cues with the reader's language and background knowledge. These sources of information allow the reader to react to printed words in numerous ways -- evaluating, checking validity, drawing conclusions and elaborating on what is implied by the author in order to arrive at intended inferences. Thus, reading comprehension cannot be thought of as one process; rather, it is a collection of interactive processes.

Anticipation appears to be a basic ingredient of all comprehension. Each activity that we perform is dependent upon our expectations about that activity. Such expectations are a result of our understanding of the world, or of our concepts of the world; that is, we are in a constant state of anticipation about how each activity will "turn out" based upon our past experience and upon our ability to generalize from past experience to the new situation. In order to make sense of our activities, we must be able to assimilate the incoming information into what we already know; that is, to be able to fit it into our already existing mental framework so that it is congruent with our anticipated outcome of the activity. If, by chance, the outcome does not coincide with our expectations, an imbalance occurs between our existing knowledge and the incoming information. We must then adjust or accommodate our known information to incorporate the new information or, if such accommodation is impossible (because of what we know), we must discard the new information as being false or inaccurate; hence, unacceptable or partially unacceptable. At that point it is often necessary to alter one's expectations for the activity and to repeat the activity so that a new, more acceptable interpretation or judgment about the results of the activity can be made.

The importance of anticipation during the comprehension of language has been described by Clark and Haviland (1977) as the "contract" situation that exists between a receiver and a sender of either a verbal or a written message. They maintain that every linguistic assertion can be broken into two parts; namely, given information already known to the receiver, and new information which the sender is attempting to convey but which is not known to the receiver. The idea is that there is an understood "contract" between receiver and sender which states that sentences will contain this given-new information. Thus, when a person is the recipient of an assertion, he divides the sentence into its constituent elements, searches memory for the given or familiar part of the message and then incorporates the new information into it.

The role of prior knowledge in this "given-new contract" situation is obviously critical. If the given information is not within the comprehender's cognitive framework, it will be difficult to generalize from any past experience to the new situation; hence, the receiver is unable to anticipate or make a prediction about what he may reasonably expect to encounter as new information. If the receiver has no idea of what to expect from the new information (because he does not have the relevant old information) understanding and representation in memory of this new information is extremely difficult, if not impossible.

Because reading is a linguistic activity and because we hypothesize about or anticipate the outcomes of every activity we engage in, every reader must necessarily make use of questions, or expectations, about the material being read if he is to understand the materials. In the reading literature such a theory regarding the use of hypothesis testing is usually referred to as an "analysis-by-synthesis" model (Neisser, 1967) or a "psycholinguistic guessing game" model (Goodman, 1976).

The analysis-by-synthesis theory was originally proposed by Halle and Stevens (1964, 1967) as an explanation of the way in which speech is understood. Since reading, like listening, is a receptive activity, the theory has been applied to reading in an attempt to understand what it is that readers do that allows them to comprehend print (see Bulcock & Beebe, 1981).

Basically, the analysis-by-synthesis model of reading says that "one makes a hypothesis about the original message, applies rules to determine what the input would be like if the hypothesis were true, and checks to see whether the input is really like that" (Neisser 1967, p. 194). That is, a listener or reader utilizes his world view and his linguistic knowledge as well as his knowledge of the task at hand to analyze the situation in which he finds himself. As he begins to analyze the print and associated sounds, in accordance with what he expects to find, he selects the cues to attend to or to focus upon. Once the appropriate cues are selected, he tries to associate meaning with them by comparing the incoming information to what he already knows, generalizing the results to the new input situation and synthesizing or bringing together the results. As he synthesizes the new ideas he assimilates them into his cognitive structures and is then able to make another prediction of what will likely follow based upon the synthesizing and the assimilation of the old and the new information. If the reading or listening activity places a person in a situation where his conceptual background is not adequate for the demands that the speech or print make, he will be unable to pose adequate questions or determine appropriate expectations and, hence, will be unable to comprehend.

The "psycholinguistic guessing game" theory may, perhaps, be thought of as an application of and extension to the analysis-by-synthesis theory with special regard to reading. Prior to encountering text, the reader has certain syntactic and semantic expectations about the information contained therein. As he begins reading he selects graphic cues in accordance with these expectations and uses this information to formulate a prediction about the intent of the message. If, when the reader tries to associate the linguistic and semantic cues in the print with his own linguistic and world knowledge structure, the comparison is favorable, he is able to synthesize the information and check it out with subsequent information in the text. If further text information confirms his synthesis, he can formulate another prediction about what is likely to occur next. If the prediction is not consistant with his world view and/or linguistic knowledge as well as the forthcoming text, the reader recognizes that he has misread at least some of the information and must, therefore, reread or reinspect the graphic display in order to alter his choice of cues, this time based on a different expectation of what he will find.

Gibson and Levin (1975) point out that Goodman's theory raises many questions about when, or at what level of language, predictions are made and checked. "Is the reader guessing succeeding letters, words, phrases, sentences, or the general plot or meaning of the text?" (p. 451). Further, at which level is the confirmation or rejection of the hypothesis made? How does the reader know where to direct comprehension?

Goodman, of course, claims that the reader is utilizing all levels of units simultaneously and is striving to select only as much information from each unit as is necessary for him to be able to anticipate or predict what is written. If the prediction does not sound like language, or if it lacks meaning, the reader must disregard his initial expectation and regress or go back for more information, especially at the letter or word level. It seems, then, that readers try to do a balancing act as they select cues from all levels of print and from various aspects of prior knowledge in order to make their predictions. Likewise, when they check out the prediction they seem to be relying on all levels of units but perhaps more heavily on their own linguistic and world knowledge as they strive to clarify the prediction of what the text contains by comparing it to their existing cognitive framework.

Hochberg (1970) supports the analysis-by-synthesis theory of reading and suggests that:

> The experienced reader must treat each important cue, each distinctive visual feature of a word or phrase, as confirmation or disconfirmation of some class of expectations and must respond with a set of expectations concerning what should follow the particular material he is reading. (pp. 78-79)

He claims that a reader is able to direct his eyes to the next important set of printed cues because he is able to pick up with his peripheral vision, cues that he can combine with his prior confirmations and his linguistic and world knowledge which will tell him where the most important information in the forthcoming text lies.

Goodman (1975) supports Hochberg's view of the importance of peripheral vision in a later paper when he states:

> The reader is constantly predicting what he will encounter and hypothesizing what syntactic patterns he is dealing with as he reads. He must do this in order to be able to make use of new perceptual information and to get to meaning. If something, however fussy, in the peripheral field fits the prediction and the hypothetical syntactic pattern, the reader may use it. Perception, hypothesis, and prediction are operating together. The apparently more accurate reading of the more proficient reader may in fact be due to more successful prediction and hypothesizing rather than more careful use of visual information. (p. 217)

Although none of the analysis-by-synthesis or psycholinguistic theorists clearly state that the prediction process is an iterative one, it seems to follow from the theory that the reader is constantly feeding back the information received from decoding the print to see whether it confirms his anticipatory hunches or hypotheses. If the feedback is positive the next unit of print is ready for decoding. If the feedback is negative -- in effect the message does not "click" -- the reader will have to go back to reread the preceding unit or units of print in order to obtain additional or alternate information. If, as a consequence of rereading, the feedback is still negative the reader may have to read ahead even further to see whether the upcoming context of the passage provides the additional clues necessary for positive feedback.

Reading becomes more selective when skill in prediction, or the reader's iterative capacity becomes more highly developed. This developmental aspect of predicting seems to be associated with the amount of experience the reader has had. A study conducted by Beebe (1976) indicates that the more experienced a reader becomes the more successful he is at making good predictions.

> ...the percentage of total miscues was higher for grade two subjects than grade four subjects, with the greatest differences occuring in substitutions, repetitions for the purposes of correcting, and unsuccessful attempts to correct. This result is not surprising, since grade two subjects have not had as much time as grade four subjects to develop the same degree of sophistication in their reading strategies. ... A beginning reader who is not efficient in eliminating alternative guesses makes more guesses, checks his guesses more often, and then regresses to correct or gain more graphic information before proceeding than does a more mature reader who has been through the initial process and has thereby developed relatively sophisticated tactics or skills for making more accurate predictions. (p. 56)

James (1979), in a doctoral dissertation, was also able to demonstrate the developmental pattern of predictive processing.

How then does one observe this iterative process that would seem to characterize proficient readers? In other words, how have researchers in this area been able to pick out the strategies that readers are using in order to predict and then verify their predictions as they strive toward understanding the author's intended message? The introductory section in Chapter I indicated that through the qualitative analysis of oral reading errors, investigators are now able to gain insights into such intricate processes. Goodman (1969), who is the founder of qualitative error analysis, believes that the term "error" is misleading because many so-called errors actually represent accurately the meaning of the text. He prefers "miscue", which implies a different though not necessarily incorrect response. Underlying this change in the way errors are perceived and, hence, the subtle shift in terminology from "incorrect response" to "miscue", is the assumption that both accurate and alternate responses are manifestations of the same cues and mental processes. Miscues, or the unexpected oral responses to textual stimuli, provide an accessible source of data upon which analyses can be conducted.

Miscue analysis is based on the belief that the quality of the miscue is more important than the quantity of miscues. All miscues are not "equal" because some retain grammatical and semantic correctness and, therefore, detract little from comprehension while others distort meaning considerably. The Reading Miscue Inventory (the instrument normally used to analyze miscues) provides the investigator with a series of questions that enables one to determine the quality and type of each miscue. These questions focus predominantly on four things: (1) how closely the miscue looks like and sounds like the text word; (2) whether or not the miscue is grammatically correct; (3) how much meaning of the text is lost because of the miscue; and (4) whether or not the reader corrects the miscue when it does not sound right and/or make sense within the passage.

The focus of the questions is on the acceptability of the miscues to the text meaning and, as a result, allows the investigator to analyze how effectively the reader uses language cues and experiential information in relation to his use of letter-sound associations. Hence, each reader's reading strategies are indicated by his strengths and weaknesses in each of the three areas; grapho-phonics, syntactics and semantics.

Discourse Processing Strategies and Reading Comprehension

In a reading situation, the information conveyed in a text is often a highly organized and interrelated set of statements consisting of complex networks of concepts and their relationships. As such, this semantic structure, or interrelationship of concepts of the text, represents the writer's underlying conceptual framework of the topic about which he is writing. It is up to the reader to integrate this semantic structure into his existing knowledge base in order to understand the intent of the passage.

If readers intuitively attempt to integrate the structures of text discourse into their own knowledge framework, one might ask how a reader's existing knowledge is organized so that it is possible to accomplish this task. Frame theory (Minsky, 1975) has been put forward as a tentative explanation. The notion is that one's knowledge is organized into high-level structural units called "frames" which can be adapted to fit new experiences by changing the details of the frame. This view is rather like Piaget's idea of accommodation. Each frame consists of a network for representing situations such as visual concepts, experienced events, or the semantic content of linguistic messages. Frames contain slots, some of which are relatively fixed on the basis of the incoming information that rounds out or adds to the conceptual framework already in existence. Frames may be linked together to form systems which represent action sequences, cause-effect relationships and additions to or extensions of knowledge structures acquired through verbal or written discourse (Minsky, 1975).

It seems then that the notion of organization is central to a reader's cognitive structure; one could say that a cognitive structure is an organized set of concepts and procedures which allows interpretation of the world. That is, repeated experiences of similar events and situations generate mental structures which represent them. The mind tends to create order and structure out of incoming information. It seeks out regularities and expects to find them again in the future. These repeated experiences, through their internal representation into schemas, or schemata, (Kintsch, 1974; Mandler, 1979) lead to the phenomena of familiarity. A schema is described by Mandler (1979) as "a cognitive structure -- an organized body of knowledge" which is "formed on the basis of past experience with objects, scenes, or events and consists of a set of (usually unconscious) expectations about what things will look like and/or the order in which they will occur (p. 7)."

One can have a schema for anything with which one is familiar; from the detailed appearance of a physical object, to the rules for playing a game, to the notion that many stories have a common structure. The sequence of events that one intuitively understands as making up a story are referred to as one's story schema. Kintsch (1977) and Kintsch and van Dijk (1978) have provided a broad description of what constitutes the organization of a story or the story structure, while Mandler and Johnson (1977), Stein and Glenn (1979), and Thorndyke (1977) have given researchers a more detailed analysis of stories in the form of story rules. Such rules state specifically how stories are mapped or laid out and are called story grammars.

A story schema may generally be described as a temporally organized set of relationships which represent common sequences of events. An individual's knowledge of what constitutes a story appears to develop gradually as a result of generalizations based on repeated experiences. Thus, one becomes familiar with the format of stories through hearing many tales in many situations. A reader's understanding of story structure then, may be thought of as an hierarchically arranged set of expectations about what will occur in a given situation; that is, a story situation. It seems from the research conducted to date by the above authors, that readers intuitively use their set of expectations about the types of elements that will be found in a story as well as the relationships between the elements to assist them in synthesizing the incoming information. Such strong expectations produce what is referred to as "top-down", or conceptually-driven processing.

The synthesizing of incoming information is also based, in part, on the limitations of working memory. Only a few items can be held in the mind at one time so, as new items come along, previously presented items must be recorded and organized into larger units or concepts if they are to be retained; that is, they must be grouped and related to what one knows as a setting, an event or an outcome. Evidence gathered by Fodor, Bever and

Garrett (1974) illustrated that words are maintained in working memory in relatively unchanged form until they can be grouped into a clause. At that point, their representation becomes more abstract and precise words are less likely to be retrieved. Since stories are a series of sentences, the necessity for recoding into concepts increases accordingly. Thus, categorizing into larger, higher-order units becomes imperative since the sheer quantity of words prohibits retrospective rehearsal of lower-level word units for later recall. Presumably, the longer and the more complicated the story, the greater the necessity to recode into higher and higher levels of concepts associated with the underlying structure of the story.

To the extent that stories tend to have a rather set structure, there are considerable limitations on the format that stories may take. Readers can utilize a relatively small set of story structures to direct comprehension and retrieval in a "top-down", or schema based fashion in which incoming information is interpreted in terms of already activated story structures. Johnson and Mandler (1979) claim that "a story may be quite new in its content, yet the set of expections about a story structure allows the listener (reader) to assign the incoming sentences to higher-level categories, which are themselves organized into still higher-level structures (p. 15)."

In contrast, when new information cannot be predicted on the basis of one's existing knowledge of story structures, readers must engage in a "bottom-up", text based or data-driven processing in which an inductive understanding of the overall structure and meaning of the text is only gradually built up. During "bottom-up" processing, a reader must hold a larger quantity of incoming information in working memory until he can figure out how to chunk it into larger units which can then be related to existing schemata. This type of processing may be used more readily at a sentence level than at a story level. It would seem that within a single sentence there are more possibilities for a variety of grammatical structures and, therefore, the likelihood that a particular sentence structure will provide an accurate fit to incoming information is less than the likelihood that a particular story structure will provide the guideline for what can be expected to follow. In addition, the shorter length of sentences makes "bottom-up" processing more realistic in terms of the load placed on working memory.

This is not to say, however, that readers do not use "top-down" processing for sentences. Obviously, they use their syntactic and semantic knowledge of language to guide sentence processing. However, this method of arriving at meaning by applying schemas or frames in a "top-down" fashion is likely to be more important in story processing, simply because of the increased amount of information load inherent within the continuous discourse of a story.

Schema concerning an event within a story, or a sequence of events can be very clearly defined, and as such, is referred to as a "script" by Shank and Abelson (1977). Their example of a script is the typical sequence of events that one expects to occur when going to a restaurant for a meal. Obviously, the acceptable and expected range of sequence is rather narrow and highly predictable. Shank and Abelson use the term "plan" to describe a more general event schema. Plans consist of very broad sets of expectations based on one's knowledge of the motivations and goals people have as they engage in various sequences of activities such as going on a holiday. Plans, then, are more tentative than scripts and depend on more "bottom-up" hypothesis formation, rather than "top-down" conceptualization. That is, scripts control our expectations of the sequence of events rather precisely, whereas plans constitute more of a general, continual hypothesis testing situation based on incoming data. Plans assist in organizing the incoming data but are easily modified in the light of information received later in a story.

The more the reader's comprehension is directed by "top-down" processing, the more it takes on an inferential aspect. Since it is impossible to attend to all of the details within a story, many are supplied by the reader's cognitive schema associated with the actual episode, rather than by the visual perception of all words. This inferential aspect of perception has been called "default" processing (Mandler, 1979) and it is simply the instantiation, or filling in with the most acceptable details.

Clearly, when reading, both types of processing will occur simultaneously. It would seem that when a reader encounters a story with a definite script format which he is able to identify from the title and/or the opening sentence, "top-down" processing will dominate the reading situation. However, if the story structure is less clearly defined at the onset of the reading, the reader will have to rely, initially, more heavily on "bottom-up" processing. As he employs the use of his knowledge of a story plan, he determines approximately where the story is going and, once into the stream of the story, it is likely that a script for episodes or connected episodes will emerge. The reader will then be able to utilize more "top-down" processing and consequently engage in more instantiation.

On the one hand we have a theory that says that the reader is controlled by his stored knowledge and on the other, a theory that says the reader responds to the text and the situation. What seems likely is that readers alter their approach to processing discourse to meet the demands of the particular reading situation as well as varying demands within the reading situation. The question still remains, however, as to what extent discourse comprehension is text-based and to what extent it is schema-based.

A recently developed procedure for attempting to assess the extent of text-based and schema-based processing is recall analysis. To utilize this technique subjects are asked to read a passage, whose semantic structure has been identified, and then have them recall the content of what they have read. In several such studies, it has been found that readers typically recall only part of the message conveyed in the passage (Crothers, 1972; Frederiksen, 1975a, 1975b; Meyer, 1974). Furthermore, the information they do recall is not a random selection of individual bits of the content; rather it consists of an organized and highly structured series of informational items from the text. That is, items are not recalled independently, but in clusters that are mutually dependent and that correspond to units of semantic information such as concepts, states, or events.

Apparently, then, the ability to understand a text involves the ability to analyze that text into interrelated semantic units which can then be assimilated into one's already existing knowledge structure and, thereby, stored for later retrieval. Such semantic processing of units occurs at different levels; some units as small as single concepts, states or events and others as large as substantial portions of a text's content which might include an entire episode within a story. Frederiksen (1977) summarizes this idea when he says that "a discourse is processed as a multilevel structure containing units as small as individual concepts and relations connecting concepts (micro-structures) and as large as macro-structures consisting of networks of connected propositions (p. 58)." The identification of these processing units is central to the study of the processes involved in language comprehension and production.

Researchers involved in recall analysis have, for the most part, used three analytic procedures for assessing how much the reader relies on the text and how well he uses his schematic knowledge to assist him in assimilating the semantic structure of the text. The first analytic procedure is represented by the work of Kintsch (1974) who used as the basis of his analysis the proposition unit. A proposition can be defined as a predicate (a verb) and all its arguments (noun, adverb, and sometimes adjectives). As early as 1970, propositions were being used as the basic unit of analysis in computer programs designed to simulate human intelligence. By 1975, the proposition had established a firm foothold among cognitive psychologists working in the area of text recall (see Kintsch, 1974;

Frederiksen, 1975b; and Thorndyke, 1977).

It seems that the proposition, which is a semantic unit, had replaced the sentence, which is a syntactic unit as the basic unit for analyzing discourse. The idea was that semantic relations, not syntactic relations, were the key to comprehension. The work of Kintsch and van Dijk (1978) illustrates the construction of elaborate networks of semantic relations found within a text. After analyzing the text in such a manner, the reader's recall of the text is analyzed in the same way. Comparisons between the two networks are then made and each recall proposition is categorized as being one of: (1) a reproduction of a microstructure within the text; (2) a reconstruction of a macrostructure of the text; (3) a metastatement such as "The story is about"; or (4) an erroneous or unclassifiable statement. Kintsh and van Dijk postulated that the more the reader reproduced microstructures from the text, the more his comprehension would be text-based; similarly, the more he produced macrostructures of the text the more his comprehension would be schema-based.

The problem with using Kintsch's proposition as the unit of analysis is that the unit represents a very small amount of semantic information. While it is true that the microstructures are related together to form macrostructures, the fact remains that the procedure is based on the assumption that the reader attends to each proposition as he reads and, therefore, attends to all information.

In direct opposition to the use of microstructures as units of analysis, story grammar advocates such as Meyer (1975), Mandler and Johnson (1977) and Stein (1978) have attempted to use macrostructures instead. The procedure for this type of analysis begins with analyzing the text into constituent parts of a story grammar; that is, into a series of episodes which have a beginning, a developmental element and an ending. Once these hierarchical elements are set out (usually in the form of some kind of tree diagram), the reader's recall of the text is analyzed by imposing the structure of the story elements onto it to see how many of the reader's recalled propositions fit into each section of the story grammar.

In between these two extremes is a third analytic procedure. Recent studies done at the University of Alberta (see Brailsford, 1981; Brake, 1981; Clarke, 1981; and Machura, 1981) have used clausal units as the basis of the recall analysis. In a sense, the use of these larger units is a reaction to both the micro-level of the propositional unit where the integration of concepts/ideas is overlooked because of the minuteness of the unit and to the macro-level of the story grammar where the units are so large that two or three integrated concepts seem to be simply joined together. The clausal unit is believed to be a viable way of capturing the best of both worlds.

As in propositional analysis, the researcher begins by dividing the text into basic units, this time clauses. The readers' recalls are then divided into clausal units and a comparison between the two is made by allocating the recall units into one of four or five categories. The categories vary somewhat from researcher to researcher but basically consist of: (1) verbatim recall of a unit from the text; (2) integrated information that has been summarized, synthesized or inferred as a result of relating incoming information to the schematic framework already in existence in the reader's cognitive structures; (3) erroneous or confused information; and (4) vague, general information or a story telling convention such as, "Then what happened was . . ." The major premise here is that the way the reader relates together the units of information abstracted from the text's semantic structure and his prior knowledge will be a reflection of the complexity of the reader's knowledge framework.

Process versus Product in Observing Discourse Processing Strategies

The processing involved in comprehending continuous discourse appears to necessitate the organization of semantic knowledge into units. It would seem that there are two stages or levels of processing involved when discourse is organized into these semantic units. Frederiksen (1977) identifies the first level as the interpretive level in which propositional units of information are selected from the text. The second level, the inferential level, involves the generation of new propositional knowledge from the interaction of the selected text information and the reader's stored knowledge of the world. That is, inferential processes operate on the informational units selected from the current textual input by combining them with the frames, concepts, or events of already existing knowledge to arrive at newly constructed information.

If, as pointed out earlier, semantic knowledge is organized into schematic units at differing levels, then the process of retrieving information from this semantic framework and linguistically expressing the retrieved units ought to reflect, in some fundamental way, the organization of knowledge into its semantic units. As Carpenter and Just (1977) point out "the surface structure of sentences reflects discourse organization principles (p. 93)." Put another way, a verbal discourse is derived from a set of informational units together with a sequencing organization which allows the speaker to convey his intentions or his perspective. So, too, when a reader is asked to read and then recall a story, his verbal account of what he has read ought to reflect the informational units he has selected to incorporate into his existing conceptual framework, as well as how he has organized the units as he integrates them so that he is able to retrieve/recall the complex network inherent in the text.

This argument, however, is somewhat problematic. The abstractive and constructive strategies that readers use during reading are internal and unobservable processes. The information conveyed in the retelling or recalling of the story is the product of the processing during reading, as well as any additional construction of information at the time of recalling. The product is always "after the fact". There is no guarantee, of course, that the two, processes and product, are synonymous. Since it is impossible to directly observe the processing of information during reading one can only rely on the product, or end result of the reading, in order to infer what strategies have been used during the reading and retelling.

The same argument could be made in the case of the writer and the text that he produces. Readers can never directly observe the thought processes that are going on in the writer's mind as he thinks about what he wishes to say. The only method the writer has of conveying his intentions or concepts is through what he puts into print; that is, the product of his thought processes. Similarly, there is no guarantee that what appears in the text is a mirror image of his conceptual framework at the time of writing. The best one can do when reading a passage is to infer from the product what it is that the writer wished to impart. The product in this case is the proxy for the process.

A Comparison of Cue Selection Strategies and Discourse Processing Strategies

As pointed out in Chapter I, the methodologies for assessing cueing strategies and discourse processing strategies have both similarities and differences as do the theories underlying them. Therefore, before attempting to empirically assess the importance of these similarities/differences, an overview of the discrepancies and corresponding aspects is in order.

Similarities of the Two Theories

Both theories recognize the key role that prior knowledge plays in enabling a reader to make sense of the print before him. Psycholinguistic theory attempts to capture a reader's use of background information by estimating a reader's syntactic and semantic cueing strategy facility. The rationale for this procedure is that a reader encounters print with an intuitive understanding of how language works as well as a repertoire of first hand and vicarious experiences that allows him to interact with print such that he can relate the incoming information to his language patterns so that it sounds sensible, and to his experiential background such that it is meaningful. Further, miscue analysis procedures allow the observer of reading behavior to "view" these strategies "at work".

Discourse strategy proponents present background knowledge as sets of interrelated schema that allow readers to interpret incoming information by "slotting" or "instantiating" the new information into these already existing frameworks. Further, the reader's schema of what constitutes a story plays a key role in allowing a reader to forecast or anticipate the "line" that a story will follow. The way in which readers organize, relate together and slot this new information allows the researcher to estimate the reader's capacity to utilize his existing cognitive frames in order to interpret printed material. The analysis of a reader's recall of what he has read, followed by a comparison with the original text, permits researchers to tentatively view some of these higher order organizational skills utilized during the interpretation of text.

Stemming from this similarity in the attention given to background knowledge in the two theories is the associated similarity of anticipation during reading. Prediction in the psycholinguistic cueing strategy model occurs at a word, a phrase, or a sentence level as well as beyond the sentence level. Because a reader is familiar with the syntactic redundancy of language, he knows that only certain kinds of words can follow other words. For example, "the" or "a" is always followed by nouns or adjectives. Action words are usually followed by nouns or adverbs. Although young readers do not usually know the "why" or the "grammatical terms" associated with such words, they intuitively know what kinds of words to expect next. Similarly, at a phrase and sentence level, readers can anticipate how a sentence will end and how the next one is likely to begin so that the paragraph or passage makes sense within their frame of reference.

Anticipation in the theory of discourse strategies is often described as a set of expectations that are based on one's schemata or cognitive structures. Such schemata are formed on the basis of past experience with objects and events and allow readers to intuitively anticipate the incoming information in relation to the activated schema relevant to the topic at hand. Such strong expectations produce "top-down" processing of data which is only interfered with when the existing schema fails to provide the necessary expectations essential for comprehending the passage. At that point, the reader must digress to "bottom-up" processing, whereby the incoming information is checked more carefully for necessary visual perceptions that can be synthesized to inductively produce a meaningful message. Such iterating between "top-down" and "bottom-up" processing is similar to the checking out of predictions suggested by the cueing strategy theory and the regressing to pick up more information when a hypothesis has turned out to be incorrect.

In both theories "as readers predict they must chunk or organize words into patterns or units" so they can be checked for meaningfulness or processed as meaningful (Fagan, 1978a, p. 234). As readers are chunking information they are able to follow the overall intended meaning and, thereby, make a prediction that allows them to chunk the next set of words to form a meaningful unit. Unless the reader can observe the relationships within the incoming information both within and across the units of an entire story, information will only be remembered in a piecemeal fashion. But how is it that a reader is able to hold units of information in memory long enough to perceive the relationship of that unit to one occuring much later in the story? Or, perhaps more importantly, how is the reader able to hold numerous units in memory so that he can establish the essential relationships among them? Both theories deal with these questions by suggesting that readers select only as much information from the text as is necessary to construct meaning. That is, readers abstract the necessary information from the text in accordance with their expectations about the upcoming information. They then summarize or synthesize ideas into a manageable form in accordance with what can be handled by the memory system. At the same time, both theories claim that the reader is using this information from the text by associating it with his background of knowledge in order to construct meaning. As the reader interacts with the print in this way, he may make transformations of the text which involve simplifications or omissions, consolidations or additions and re-transformations or substitutions. According to cueing strategy theory such transformations as omissions, additions or substitutions tend to occur, for the most part, at the word level. Discourse processing theory suggests that simplifications, consolidations and retransformations occur across much larger units of meaning. Both explanations, then, claim that readers selectively process text using information both from the text and from their knowledge of the world as they construct an interpretation of the passage.

Three other similarities are worthy of mention even though they are concerned with the methodology of the analyses. First, both analytic procedures are concerned with in-depth, qualitative evaluations of the processes underlying comprehension. Miscue analysis is concerned with the qualitative analysis of miscues in an attempt to identify the cueing strategies a reader utilizes. Recall analysis is concerned with the qualitative nature of the units of information recalled when reading continuous discourse. Here an attempt is made to assess whether the units processed and later recalled are verbatim, inferential or erroneous in nature. Second, both types of analyses are concerned with identifying variables; that is, with measuring theoretical concepts that can assist in accounting for the variation among reader's abilities to comprehend. Finally, both analyses are based on the expression of comprehension in addition to the reception of comprehension.

Differences in the Two Theories

The first major difference between the two theories is the focus on what strategies are emphasized. The analytic procedures associated with the psycholinguistic theory enables an observer to look at the cueing strategies that a reader brings to and utilizes during the reading situation. These grapho-phonic, syntactic and semantic strategies allow the reader to interact with the text in such a way so as to produce a meaningful interpretation of the print. It should be emphasized, however, that such analytic procedures focus predominantly on the sentence/phrase level of processing. While it is true that some consideration is given to semantic acceptability of miscued words within a paragraph and the consequent change in meaning beyond the paragraph, the key criteria for evaluating the acceptability of miscued words is the acceptability of the word within a phrase or sentence.

Recall analytic procedures, on the other hand, attempt to shed light on the organizational strategies that a reader uses as he interrelates the ideas within and across sentences as well as within and across paragraphs. That is, recall analysis is primarily concerned with larger units than miscue analysis and, therefore, attempts to evaluate the organizing and synthesizing that occurs during the higher level processing of paragraphs and whole passages.

The second major difference between the two theories is the point in time at which the processes associated with each theory are observed. The analytic procedures for the psycholinguistic theory provide insight into the reading process as the processing is in progress. As in recall analysis, though, the observations are still dependent upon the product of reading. In this instance, the product is the oral reading miscue which occurs concurrently with the reading. This means that in miscue analysis the product is immediately available to the observer. In other words, the product is available as the processing is going on, whereas recall analysis attempts to gain insight into the processes involved during reading and recalling by looking at the recall that the reader gives after reading.

There seem, then, to be two major differences between the two methods: (1) the strategies observed; and (2) the point in time at which the observations take place. The data for psycholinguistic theory, on temporal grounds, precedes the theory associated with recall analysis. That is, the observation of cueing strategies is temporally prior to the observation of discourse processing strategies simply because miscues occur during the reading whereas the retelling, or recall, which exhibits the organization of the incoming information occurs after the reading.

The two theories, then, appear to complement one another since they are illuminating different aspects of a reader's processing. The only way to evaluate their complementarity is to set up a measurement model that will test the similarities and differences with empirical data.

A Complementary/Competing Theory

It was shown in the previous section that there are two current theories for explaining reading comprehension: one emphasizing the psycholinguistic cueing strategies that a reader brings to the reading situation which allows him to predict and then verify his predictions as he interacts with the print; and, another emphasizing the manner in which prior knowledge is used to reduce a large set of propositions within a text into a smaller set of propositions that are generalizations, or more complex concepts, made available to the reader through his ability to organize incoming information into these larger "macrostructures". To date, these two theories underlying the procedures have been treated in the literature as alternatives, and perhaps even competing explanations of the processes involved in comprehending while reading, despite the fact that there appear to be commonalities between them. This would seem to suggest that the two theories are complementary rather than competing. In order to test whether the theories are competing or complementary in a recursive manner, a cueing strategies/discourse processing strategies theory may be formulated. The relationships in such a theory are shown in Figure 1.

Since the abilities inherent in each set of strategies are considered as plausible antecedents of reading comprehension, the parameters of both sets of relationships will be estimated simultaneously. If, in this situation, the relationship between cueing strategies and reading comprehension is reduced so that the coefficients are no longer significant or are effectively zero, then the cueing strategy theory would be insignificant due to the overriding importance of the discourse processing theory. Hence, the competing problem would be resolved in favor of discourse theory. If, on the other hand, discourse processing strategies were found to be insignificant in the presence of cueing strategies, then theory one could claim to be the acceptable explanation of reading behavior and theory two would be redundant; hence, unacceptable because theory one would have overridden it.

The competing approach, with its built-in either-or assumption, may be less productive than a complementary or integrative approach. The problem is not so much one of kind; that is, of establishing the existence or non-existence of "the" (one and only) explanation, but rather one of degree. The question really is, to what extent are some of the cueing strategy parameter estimates reduced in the presence of additional predictors suggested by discourse processing strategies (or vice versa) and to what extent is the explanatory power of an integrated

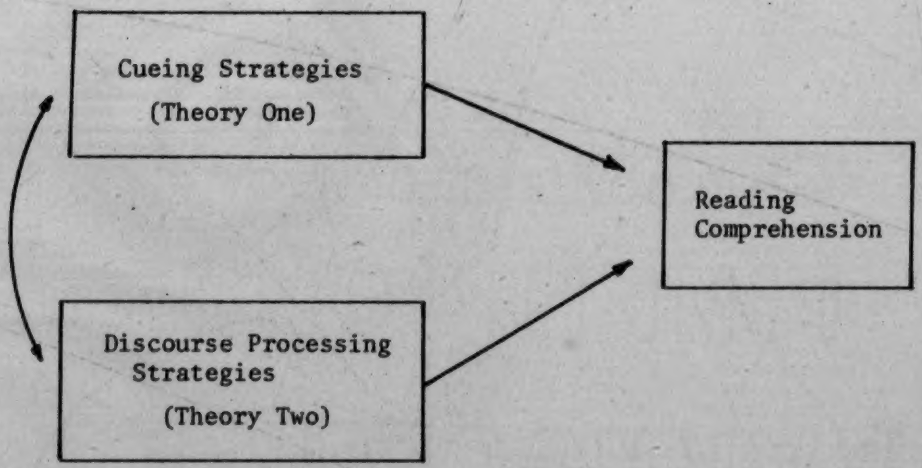

FIGURE 1. Conceptual Diagram of a Complementary/Competing Theory

theory greater than that of either theory one or theory two considered independently? While it is true that both theories have several similarities, it may be argued that the differences that exist do not make one theory more viable than the other. Rather, the differences can be seen as tending to justify the thesis that the two explanations are complementary rather than competing.

CHAPTER III

THE DESIGN OF THE STUDY

The first purpose of this chapter is to specify the relationships of the components of the two theories such that they can be tested empirically. Second, the components are disaggregated into measurable entities, or variables, which can then be translated into the mathematical component of the study. Hence, this chapter can be seen as giving an overview of the conceptualization of the theory which results in testable hypotheses. The hypotheses, in turn, are translated into the measurement model; that is into variables that capture the relationships posited between the components of the theory. Third, a description of the sample on which the theoretical hypotheses were tested is included.

Three Models of Reading Comprehension

The purpose of this section is twofold: (1) to translate the theoretical models of cueing strategies and discourse processing strategies into measurement models, thereby disaggregating the components of the two theories into measurable entities; and (2) to integrate the two models into a more comprehensive model.

The Cueing Strategy Model

The cueing strategy model was based upon the premise that reading involves the simultaneous and interactive processing of: (1) graphic and phonic information, or the letters and their associated sounds, conveyed through the configuration of letters in a line of print, sentence, or paragraph; (2) the syntactic, or grammatical, cues inherent in that line, sentence, or paragraph; (3) the semantic, or meaning, cues associated with the reading material; and (4) the interrelationships among (1), (2), and (3) within the reader's repertoire of prior knowledge, including knowledge about language.

A reader's usage of these three cue systems is determined by the balance of strategies, or how much of each, he utilizes during reading. We cannot hear what a child reads during silent reading; therefore, we rely on oral reading to provide insight into the strategies the reader employs. But we cannot tell what methods are utilized if the reader reads correctly; hence, we must examine oral reading errors or miscues on the assumption that the same cues trigger incorrect responses as trigger correct responses.

Since the 1960's miscue analysis has enabled researchers to gain insight into the degree of interplay of the graphic, phonic, syntactic and semantic information that readers utilize during the decoding of print into meaning. A workable procedure for identifying the four components of miscue analysis theory was developed by Yetta Goodman and Carolyn Burke in 1973 when they published the now, well known Reading Miscue Inventory. Although several modifications have been made to the RMI procedures outlined by Goodman and Burke, reading researchers, clinicians, and teachers alike have utilized the underlying principles of qualitative error analysis to evaluate the interplay of a reader's language knowledge and background of experience with the text at hand. The four components of miscue analysis that have been identified and continue to be used by the proponents of the procedure are: (1) the graphic cueing strategy; (2) the phonic cueing strategy; (3) the syntactic cueing strategy; and (4) the semantic cueing strategy.

The ability of a reader to effectively utilize each of these cueing strategies is believed to affect that reader's comprehension during reading. The conceptual model used to estimate the degree of influence of the graphic, the phonic, the syntactic and the semantic strategies on reading comprehension is presented in Figure 2.

The Discourse Processing Strategy Model

Tierney and Bridge (1979), among others, believe that by analyzing a text and comparing a subject's recall of the text to the structure of the text itself, the nature of the reader's organizing procedures can be derived. According to Drum and Lantaff (1977) the gist that readers remember during reading is the product of selecting and arranging the elements within the text into a summary of the content of that text. The arrangement and integration of the selected information is believed to be based on the reader's prior knowledge, the anticipation of what the reader expects to find, and the way in which the text is structured, as well as the reader's ability to interrelate items within and across sentences and paragraphs. Therefore, if readers' free recalls are analyzed to try to determine what kind of information they have selected from the text to arrange and organize into a summary, together with how they have arranged and organized this information, it may give insight about the processes involved in reading over-and-above the insight provided by considering the components of cueing strategies. That is, by examining the "what"

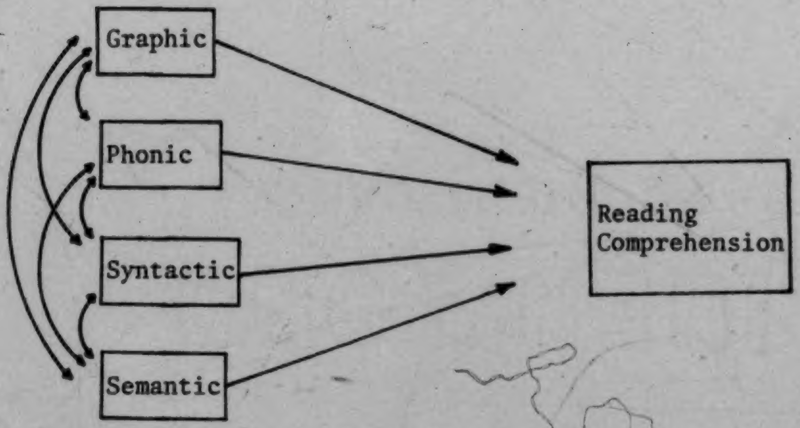

FIGURE 2. Conceptual Diagram of the Cueing Strategy Model

and the "how" of the abstractive and constructive processing of print, added insight may be gained as to just how the reader is utilizing cueing strategies (or thinking/reasoning abilities) to comprehend print. It is suggested, then, that the discourse processing strategy model may be disaggregated into two sub-models, one (the "what") which refers to the content of recall, and the other (the "how") referring to the structure of the recall. These are discussed separately.

A Content Sub-Model. In order to achieve this end it is suggested by researchers such as Drum and Lantaff (1977) and Fagan (1980) that, when considering the analysis of readers' recalls, categories be utilized for judging the kind of information that is generated by the reader. In order to categorize the information, the recalls are first divided into clausal informational units. Each unit is then assigned to one of four categories. The sets of categories suggested by researchers are similar (see Drum and Lantaff, 1977; Furness, 1978; and Fagan 1980) and the set chosen for the purposes of this study was based on the set compiled by Fagan. This choice was made because Fagan's guidelines for the allocation of units into the appropriate categories are the most precise. The categories include the following: (1) text specific (verbatim or paraphrase information); (2) text entailed (inferential information, synthesis of two or more units, or a summary of information); (3) text erroneous (inaccurate information); and (4) text external (vague generalizations or story conventions). These categories constituted the first dimension or component of recall analysis and are referred to as the "Content of Recall" dimension.

A conceptual diagram of the relationship between the Content of recall or "what kind of information is recalled" and reading comprehension is presented in Figure 3.

By analyzing the units of information given in a reader's recall the analyst can estimate at least two processes. First, one can assess how much the reader is relying on trying to memorize exactly what is in the text; and second, how much he is attempting to incorporate the new information into his old or already existing framework and, as a result, reproduce a recall that has a high degree of inferred, summarized or constructed information. Text entailed information, then, could be thought of as requiring a more complex kind of processing or thinking than text specific information. The analysis of erroneous and external information also adds insight into the processing activities, especially if the reader has not miscued unacceptably during the reading. Cofer, Chmielewski and Brockway (1976) go so far in this regard as to claim that it is the reader's background knowledge (or lack thereof) that is presumably the source of inaccuracy when readers misinterpret text and consequently give erroneous information during recall. Misinformation, then, may be due to inadquate or inappropriate background for the passage being read.

Mazes, which include false starts, repetitions, corrections or voiced pauses (um, ah), appear to be related to a speaker's attempt to structure or organize his output (Fagan, 1978b, p.171). Rather than being viewed as errors or inappropriate utterances during a recall situation, mazes are now believed to possess various functions, some of which include: (1) a stopping tactic used to plan the skeleton of a major utterance; (2) a pause to select precise words for the next portion of the major utterance; (3) a hesitation while searching for a particular word or to include something that has been forgotten; and

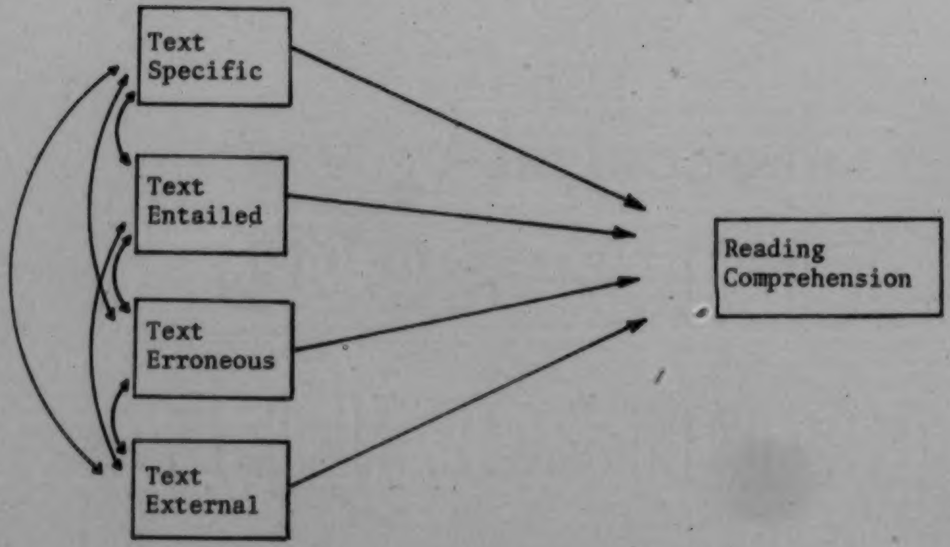

FIGURE 3. Conceptual Diagram of the Content Sub-Model

(4) a change of plans in wording or correction of an erroneous utterance (Fagan, 1978b, p.172-173). Mazes, then, are not part of the kind of information that a reader abstracts from the text; rather they can be thought of as a "stalling tactic" which is used during a recall to give the speaker time or organize and decide on how he will present his next peiece of information. For this reason, mazes were screened out of the recall passages. They were believed by the researcher not to be indicative of what the reader was doing during reading; rather, they were a devise used only during the verbal recall in order to give the reader time to think of appropriate words.

A Structure Sub-Model. As pointed out earlier, in addition to the kind of information generated during recall, the present researcher wished to know how the reader was structuring and interrelating information during the recall of the story. Fagan (1978b) has suggested three linguistic devices that signal the relationships inherent in the information of a reader's recall; namely, staging of the recall, referential connectives within the recall, and logical connectives within the recall. Staging refers to the number of independent topics included in the recall, the degree of elaboration of these topics, and the way in which the topics are sequenced. In a sense, staging gives an indication of what the reader perceives to be the structure of stories or the schema for stories. Staging constitutes the first component of the "Structure of Recall" dimension.

Referential connectives include words that refer to another noun or pronoun or to an idea already mentioned. Examples of referential connectives are pronouns, repetitions of lexical items, synonyms, and formal repetitions of nouns. This type of analysis enables a researcher to evaluate the links or ties between and within each of the clausal boundaries presented in the recall. Referential connectives constitute the second component of the "Structure of Recall" dimension and are ten in number.

Logical connectives are conjunctions and convey the logical relationships that occur between and within clausal information units. Eleven different types of connectives are identified which seem to fall into three groups: (1) descriptive connectives which depict relationships between equivalent units and the manner or mode of the relationship; (2) explanatory connectives which express relationships of cause and effect, reasons for events, agreements in favour or against an event, contrastive events and conditions or limitations of events; and (3) perceptual connectives which emphasize the time and/or spacial dimensions of events. By examining the logical connectives a reader uses, an attempt can be made to discover how the reader relates bits of incoming information together into a meaningful whole. These three groups of connectives constitute the third component of the "Structure of Recall" dimension.

A diagrammatic representation of the effects of the structure of recall upon reading comprehension is presented in Figure 4.

The underlying assumption in analyzing the recall dimensions is that the way the reader subconsciously selects and organizes information as he reads the passage is portrayed in the way he organizes and presents the gist of that passage in the unaided recall situation. Therefore, an examination of the kind of

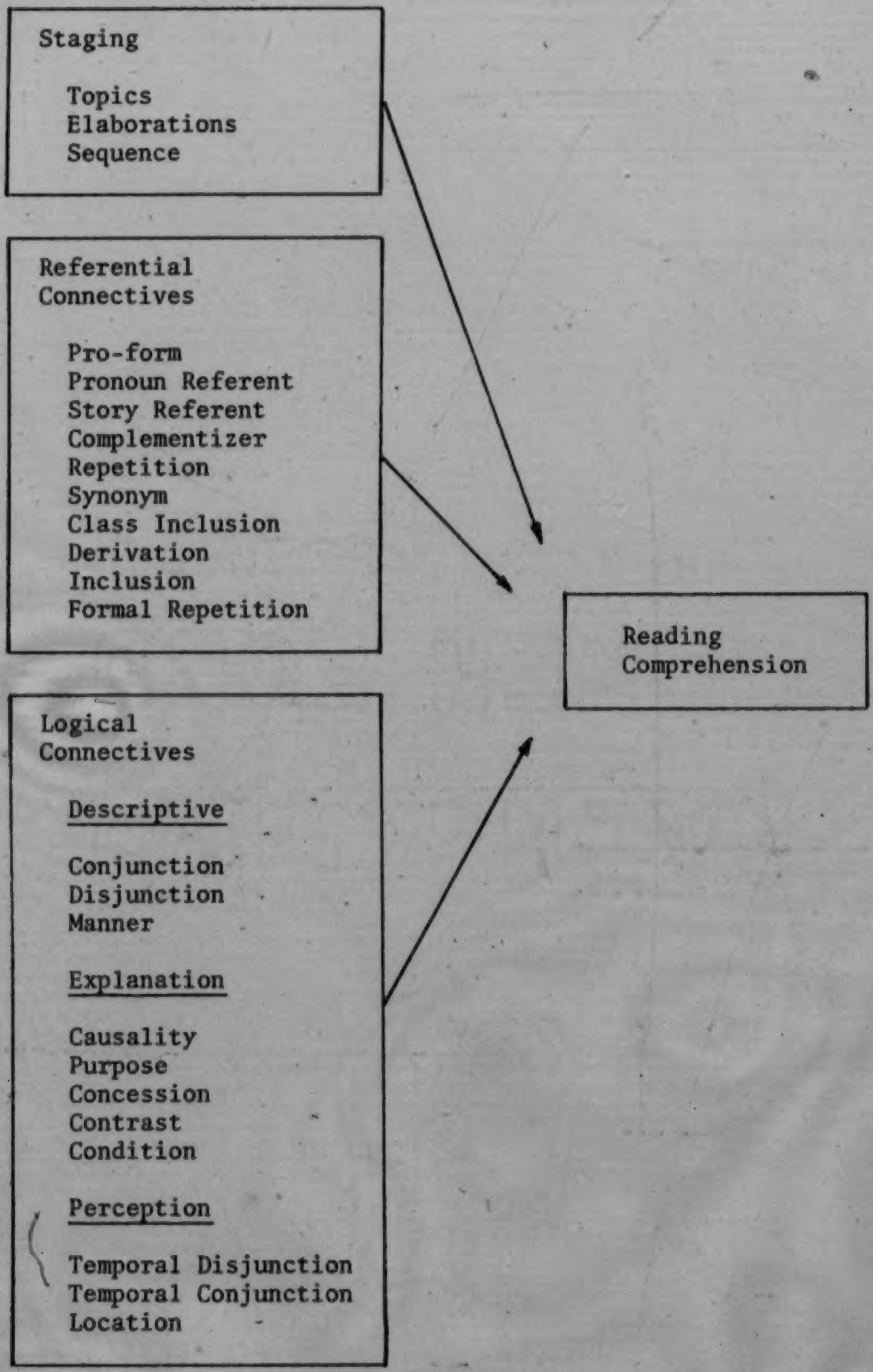

FIGURE 4. Conceptual Diagram of the Structure Sub-Model

information conveyed and the way in which it is structured during recall is assumed to shed light on what information he selected from the passage, as well as, how he related that information to prior knowledge in order to make the necessary inferences, and how he structured the information (or misinformation) into a summary of the content of the passage.

An Integrated Model of Reading Comprehension

When the two sub-models are integrated into a more comprehensive model, the relationships can be estimated in order to find out whether the cueing strategy theory and the discourse processing theory are competing or complementary theories. In addition both the direct and the indirect effects of the strategies of the two models on reading comprehension can be assessed. A diagrammatic representation of the integrated model is presented in Figure 5.

The respecified relationships suggested in Figure 5 are based on the notion stated in the previous chapter that the reader's use of cueing strategies is observable prior to the observation of discourse processing strategies. The legitimacy of placing cueing strategies prior to discourse processing strategies is also supported by the fact that when a reader makes a miscue, he has only a limited amount of print behind him on which to partially base his expectation. While it is correct that readers pick up clues about the upcoming print from peripheral vision, the print that has already been processed, plus expectations based on background knowledge, contribute the greatest amount toward what the reader thinks will occur next and, consequently, to any miscue.

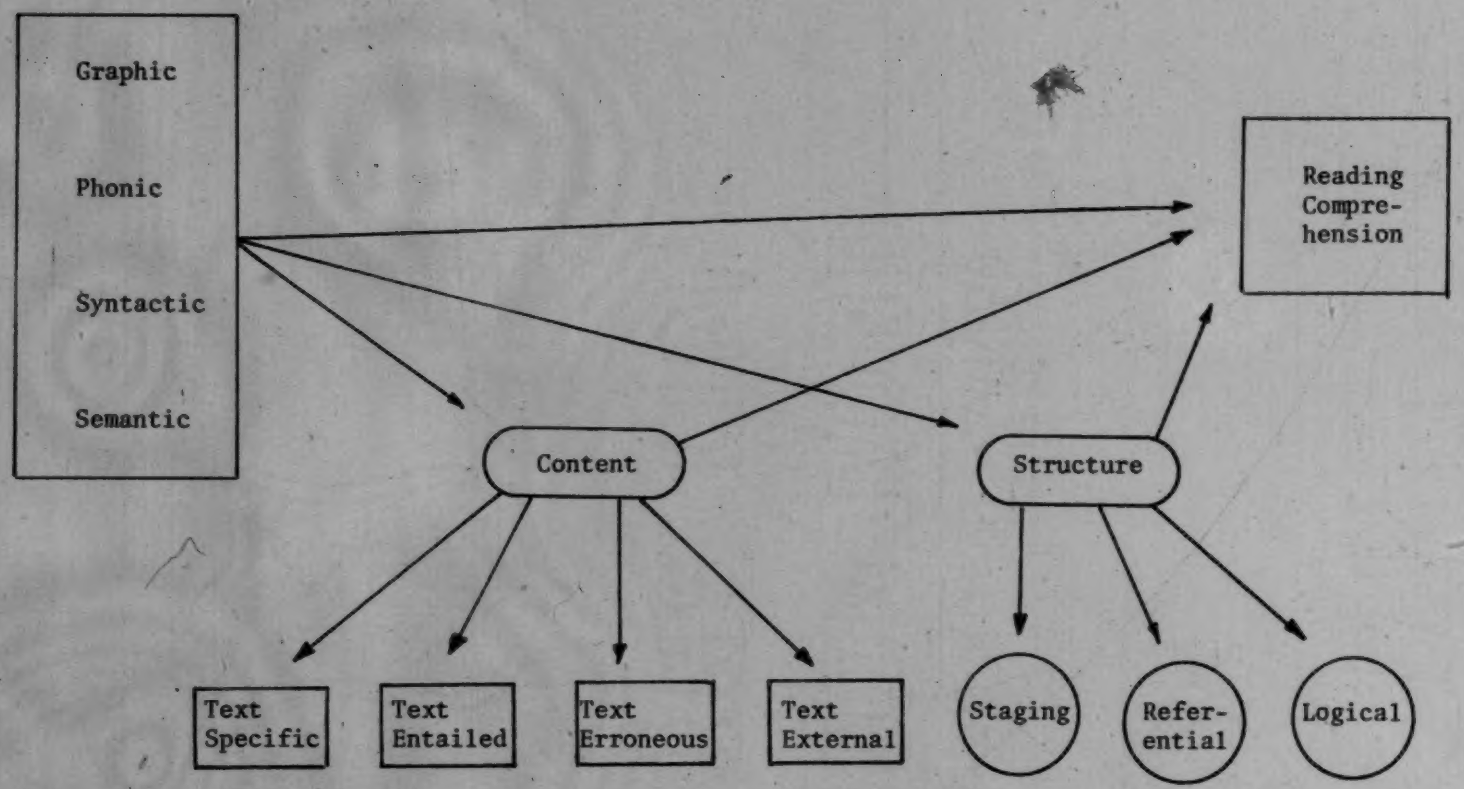

FIGURE 5. Conceptual Diagram of an Integrated Model of Reading Comprehension

However, when a reader recalls what he has just read, he has processed all of the print available to him and, hence, has the complete passage behind him on which to base the organization of the abstractive information as it interacts with background knowledge. In this sense, then, one could argue that the information conveyed by the reader as he recalls the passage may yield additional insight into the processing of print over-and-above the information yielded during the reading as observed through a reader's miscues. Hence, the two theories are seen as complementary to one another.

It should be mentioned that while the researcher realizes that there may be reciprocal relationships between the cueing strategies and the discourse processing strategies, it is beyond the scope of this study to estimate such parameters. Estimation of reciprocal relationships necessitates the construction of a dynamic model. In this study the formulated model is a static model; hence, the analysis is based on a set of recursive model relationships in which miscue measurement occurred at a point in time before the measurement of discourse processing variables.

Hypotheses

The hypotheses for the study flow from and are supported by the theoretical framework underlying cueing strategies and discourse processing strategies presented in Chapter II. The criteria for acceptance or rejection of each hypothesis was whether or not the parameter estimates were significantly different than zero.

Hypothesis 1A: The greater the dependency on the graphic and the phonic strategies the lower the reading comprehension score, when taking into account the effects of the syntactic and semantic strategies.

Hypothesis 1B: The greater the proficiency in syntactic and semantic strategies the higher the reading comprehension score, when taking into account the graphic and phonic strategies.

Hypothesis 2A: The greater the amount of text specific information given, the lower the reading comprehension score, when taking into account the effects of the other Content domain variables.

Hypothesis 2B: The greater the amount of text entailed information given, the higher the reading comprehension score, when taking into account the effects of the other Content domain variables.

Hypothesis 2C: The greater the amount of text erroneous information given, the lower the reading comprehension score, when taking into account the effects of the other Content domain variables.

Hypothesis 2D: The greater the amount of text external information given, the lower the reading comprehension score, when taking into account the effects of the other Content domain variables.

Hypothesis 3A: The more consistent the staging of the recall with the story text, the higher the reading comprehension score, when taking into account the other Structure domain variables.

Hypothesis 3B: The greater the number of logical connectives used the higher the comprehension score, when taking into account the other Structure domain variables.

Hypothesis 3C: The greater the number of referential connectives used the higher the comprehension score, when taking into account the other Structure domain variables.

Hypothesis 4: The Content variables will have a significant and positive effect on reading comprehension over-and-above the effects of the Structure domain variables.

Hypothesis 5A: The greater the dependence on the graphic and the phonic cueing strategies the lower the performance in the Content domain when taking into account the effects of the syntactic and the semantic cueing strategies.

Hypothesis 5B: The greater the dependence on the graphic and the phonic sueing strategies the lower the performance on each of the dimensions of the Structure domain when taking into account the effects of the syntactic and the semantic cueing strategies.

Hypothesis 5C: The greater the proficiency in syntactic and semantic cueing strategies the higher the performance in the Content domain when taking into account the effects of the graphic and the phonic cueing strategies.

Hypothesis 5D: The greater the proficiency in syntactic and semantic cueing strategies the higher the performance on each of the dimensions of the Structure domain, when taking into account the effects of the graphic and Phonic cueing strategies.

Hypothesis 6A: The discourse processing strategies will have positive and independent effects on reading comprehension scores when simultaneously taking cueing strategy variables into account.

Hypothesis 6B: Some of the effects of the cueing strategies on reading comprehension will be mediated by the recall strategy variables.

Sample

Ninety four grade four pupils from two urban schools constituted the case base for the study. There were 131 students in the grade four classes, but, since it was necessary for all the sujects to be able to read the same passage and yet make mistakes, it was decided to select only those who were reading close to or above grade level. They would all then be able to read a passage difficult enough to produce reading miscues.

Maze 5 and Maze 6 of the Guthrie-Seifert Maze Task were administered to all students in order to select the sample. The Guthrie-Seifert Maze Task is a modification of the cloze procedure. Instead of inserting a word in a blank, the reader must select one of three alternative words that are embedded for every fifth word in the story. The percentage of correct selections indicates the degree of comprehension for that passage. The Maze instrument contains seven passages graded from primer to 6.1 in difficulty. Maze 5 corresponds approximately to a grade 4.5 level and Maze 6 to a grade 5.2 level. Each test contains 28 items with a resulting total possible score of 56. The cut-off point for inclusion in the sample was a total of 40 points out of the possible 56, which meant that the students were comprehending at least 70 per cent of what they read and should, therefore, be capable of orally reading the passage contained in the study instrument. The validity and reliability of the instrument is described in an article by Guthrie (1973), where he demonstrates that it correlates at the 0.82 level with the Gates-MacGinitie Comprehension Subtest.

The Dependent Variable

The reading comprehension measure was a grade equivalent score from the administration of a battery of tests known as the Canadian Test of Basic Skills (King and Hieronymus, 1973). The reading test selections varied in length from a few sentences to a full page and each passage was followed by multiple choice questions. Pupils were required to answer 68 items in 55 minutes. King and Hieronymus (1975) report a split-half reliability of 0.92 for the Reading Comprehension subtest of the Canadian Basic Skills battery.

It is pointed out that a silent reading measure has been used for a dependent variable, and measures based upon oral reading for the independent variables. The question arises as to how similar are oral and silent reading and can the phenomena that underlie the processes involved in oral reading also be assumed to underlie the processes involved in silent reading. The essential question, then, concerns the nature of the relationship between the two modes. The underlying assumption of researchers and practitioners using oral reading to provide information about the process of silent reading is that the two modes have much in common.

In a recent book by Levin (1979), a chapter is devoted to reviewing and evaluating the research that has compared oral and silent reading. The two modes of reading were compared in five areas: (1) the nature of the text; (2) the characteristics of the reader; (3) eye movements; (4) reading speed; and (5) comprehension and memory. A summary of Levin's views follows.

In the first area, the nature of the text, studies have been conducted on size of type variations, grammatical and meaning structure variations, variations from one language to another, variations in type of prose (fiction versus nonfiction), and whether prose or poetry was read. The general finding was that, although there are some differences such as longer duration of visual fixations for oral reading in every language, the surface characteristics of the text had little influence in producing differences in oral and silent reading. Comprehension, when varying the surface features, remained the same in both modes.

The characteristics of readers that were thought might produce differences in oral and silent reading performance were the age of the reader and the reader's skill. Although the studies generally agreed that older children read faster silently than orally, it seemed that younger children read at about the same rate in each mode. There was considerable disagreement as to what age the silent mode became faster than the oral mode. However, the number of ideas reproduced per second of reading, in a recall situation, was about equal for both types of reading across various age groups.

The question of reading skill concerned whether or not those readers who read well aloud also read well silently. The contention was that there is little difference. The correlation between the oral comprehension scores and the silent reading comprehension scores indicated that readers understood equally well in both modes.

Eye-movements in reading have been studied for many years probably because it is often considered to be the most "scientific" method of studying reading behavior. The results of the studies are fairly consistent; there are more fixations in oral reading than silent reading. There also appear to be more regressive eye movements in the oral mode, perhaps because oral reading, being slower, requires more regressive movements in order to remember earlier text. Eye regressions also allow time for the voice to catch up with the eyes. It was found, as well, that eye movement differences in the two modes increased with reading ability, age, and school grade. Finally, since there are more fixations during oral reading the distance between the fixations, or the "span of recognition" will be shorter for oral than for silent reading.

The literature comparing the rate of reading between the two modes is voluminous. All investigations report that silent reading is faster than oral reading which coincides with the reported evidence on increased fixations and decreased spans of recognition. Such differences are universally explained by physiological factors. Speaking the words aloud simply reduces the reading rate.

Whether readers are better able to understand and remember content after reading silently than after reading orally has also been studied for many years. Some early studies found that there were no differences in the number of points remembered when reading in either mode. Other studies testing for memory after reading often found superior memory for silent reading. Controversies over the amount of understanding in each mode have continuously appeared in the literature. Some believe that the added auditory stimulation of oral reading aids comprehension, while others claim just the opposite, that it detracts from concentration and, hence, lowers comprehension. Still others suggested that it made no difference since comprehension is not based on such peripheral factors.

More recent research shows consistently that there is little difference in the comprehension ability of readers when reading silently or orally. This appears to be so even when the readers are asked to read for a fixed length of time, with fixed amounts of material or if given varying amounts of time to read the passages. Such research has "concluded that the central processes underlying comprehension were similar in both types of reading" (Levin, 1979, p.37).

According to Levin there are enough similarities in the two modes to warrant the practice of using oral reading to observe the processing underlying something more global called reading ability even though there are some differences that one needs to be cognizant of when extrapolating from one to the other. Levin concludes his chapter by giving the following summary of the similarities and indicating that reading in either mode involves the extraction of meaning from print.

> What are the similarities? First of all the curves plotting the development of reading skills for the two modes were parallel, though skill in silent reading developed more rapidly. Second, those readers who performed well in one mode also did well in the other. Third, memory for text was superior after silent reading, though text was understood equally well in both modes. Fourth, perception of text, as indexed by eye movements, was similar for both modes. More skilled readers used more efficient eye movements when reading either silently or aloud. Fifth, difficulties in reading material led to characteristic regressions and sometimes ... to confused eye movements, during both types of reading. Sixth, as was shown by the eye-voice span studies, skilled readers processed the text in systematic or meaning units. Most investigators inferred that the 'idea' or 'meaning unit' is operative in silent reading.(p.37).

Anderson and Dearborn (1952) who emphasized the similarities of the processes in their study concluded that;

> The evidence suggests rather that silent reading and oral reading are significantly related and have many elements in common. An alternate hypothesis, therefore, is that oral and silent reading may be the overt and implicit expressions, respectively, of the same fundamental process. (p.160).

Some researchers regard such a conclusion as too optimistic. However, strong support for the claim was found in a study conducted by Beebe (1980). The research attempted to determine to what extent substitution miscues affected silent reading comprehension as well as retelling ability following oral reading. It was found that corrections and syntactically-semantically acceptable miscues were common predictors of silent reading comprehension and retelling ability based on oral reading; that is, that the covariation in understanding in the two modes of reading were equally affected by the same predictors. Covariation between the residuals of the outcome variables was negligible. These facts lead to the conclusion that an analysis of oral reading miscues is an effective way of inferring what kinds of miscues may occur during silent reading. If this is so, then the reading strategies derived from an analysis of miscues could be assumed to be operating during silent reading as well. Hence, there is additional legitimacy for using an oral mode of reading in this study to observe processes believed to underlie the silent reading used as a dependent variable.

The question then arises as to whether the assumptions underlying the construction of the Reading Comprehension Subtest of the Canadian Test of Basic Skills (CTBS) are the same as the assumptions underlying the measurement of cueing strategies and discourse analysis strategies and whether, in fact, they are therefore trying to measure the same kinds of reading skills. The philosophy of the CTBS is outlined in the Canadian Test of Basic Skills: Manual for Administrators, Supervisors and Counsellors (1975). The Reading Comprehension Subtest is summarized in the following way.

> The reading process as defined by the items in this test is a complex one. Whether or not pupils are good readers depends not only on the extent to which they apprehend the author's meaning, but also on the degree to which they grasp the significance of the ideas presented, evaluate them, and draw useful conclusions from them. This is true at all developmental levels. Children do not suddenly learn to read with comprehension at any particular age or grade.
>
> For these reasons, the items in all levels of the tests place a premium on understanding and drawing inferences from the reading selections. (p.43).

It is believed by the researcher that such a view of the reading process is compatible with those presented in Chapter II. The skills that the test is attempting to assess include: (1) the understanding of factual details and their relationships; (2) the recognition of main ideas which involves a synthesis of information; (3) an ability to organize ideas within paragraphs, across paragraphs and over time; and (4) the ability to evaluate what is read through making generalizations about a selection, recognizing the writer's viewpoint, mood and style of structure. For a more detailed description of the skills tested see Appendix 1. It seems from these descriptions, then, that the test used for measuring the dependent variable is attempting to measure the same kind of phenomena that is underlying the use of cueing strategies and discourse processing strategies.

Construction of Independent Variables

The passage selected for the students to read and recall was from the Reading Miscue Inventory and was called "Space Pet" (see

Appendix 2). It had previously been "tested" on grade four students (Beebe, 1976) and found suitable for the purposes of miscue analysis and for evaluating recalls for children at that grade level. The passage contains 741 words and is, therefore, longer than any passages used to date for recall analysis. The reasons for selecting a long passage were twofold: (1) the passage needed to be of sufficient length to ensure that the readers produced an adequate number of miscues for analytical purposes; and (2) the length of the passage was representative of story length in basal readers; that is, it was indicative of what grade four children are expected to read in a natural classroom setting.

The children were tested individually and told that after they had read the story aloud, they would be asked to retell the story in their own words. Immediately following the reading, each child retold as much of the story as he could remember. All sessions were audio taped.

Cueing Strategy Variables

In order to establish cueing strategy scores, each miscue was marked on a typed worksheet. This involved replaying the oral reading section of the audio tape as often as was necessary in order to ensure that all miscues were transcribed according to the guidelines suggested in the RMI. Each miscue was then coded on a Reading Miscue Inventory Coding Sheet under the sections graphic similarity, sound similarity, correction, grammatical acceptability and semantic acceptability. Using the guidelines from the RMI manual, a graphic similarity score was assigned to each miscue as was a phonic similarity score, a syntactic acceptability score and a semantic acceptability score. The procedures for scoring the variables are outlined below. An example of the coding procedure using the Coding Sheet is shown in Appendix 3.

Graphic Similarity. Graphic similarity referred to how much the miscue looked like the word that was actually in the text; that is, how similar it was to the expected response. A miscue could be: (1) highly similar, if two out of the three parts of the word (beginning, middle and end) looked the same; (2) somewhat similar, if one out of the three parts looked the same; or (3) dissimilar, if no parts looked the same. For example, if a reader read "our" for "your", the miscue was similar to two parts of the expected response (middle and end) and was, therefore, highly similar. However, if the reader read "care" for "canary" it was only somewhat similar and if he read "the" for "a" it was dissimilar.

Miscues that were highly similar received a score of two; those that were somewhat or partially similar a score of one; and those that were dissimilar a score of zero. A student's graphic similarity raw score was established by totaling the two's and the one's. This raw score was then converted to a percentage by using two times the total number of miscues made as the denominator since each miscue had the potential of receiving a score of two if it was highly similar. It should be noted that if the miscue was an omission or an insertion it could not be given a graphic similarity score since comparisons to the text word could not be made. Hence, omissions and insertions did not receive a raw score nor were they included in the denominator for this variable.

By looking at percentages, all students had an equal opportunity of achieving a score of 100 regardless of the initial number of miscues made. For example, a student who made a total of thirty miscues, of which fifteen were highly similar and five were somewhat similar, would have a percentage graphic score of $\frac{(15 \times 2) + (5 \times 1)}{2 \times 30} = 58\%$. This is contrasted with a student who made sixty miscues with forty-five highly similar and nine somewhat similar, whose resultant graphic score would be $\frac{(45 \times 2) + (9 \times 1)}{2 \times 60} = 83\%$. Since we know that the total number of miscues is not a valid predictor of reading comprehension, one way of looking at the quality of the child's miscues is to compare the number of similar miscues to the total number that he made.

Phonic Similarity. Phonic similarity referred to how much the miscue sounded like the word that was expected. As with graphic similarity, the miscue could be highly similar, somewhat similar or dissimilar depending upon how many of the three parts of the word sounded the same as the text word. For example "Clarbul" for "Claribel" would have high sound similarity; "carrot" for "canary" some similarity; and "away" for "any" would have no similarity. The raw score and percentage score for the phonic similarity variable were established in the same manner as for the graphic similarity variable.

Syntactic Acceptability. Syntactic acceptability referred to whether or not the miscue rendered the sentence structure in which it occurred grammatically acceptable. A miscue had a high degree of acceptability if it afforded the sentence in which it occurred grammatical acceptability. If a miscue was grammatically acceptable only with the sentence portion that came before or after it, the miscue was said to be only partially acceptable and, hence, received a score of one instead of two as in high acceptability. Miscues that occurred in a sentence that was not in any way grammatically acceptable were declared to be unacceptable and given a score of zero. Should the miscue be corrected by the reader, it was considered to be highly acceptable and given a score of two.

Once a total raw score was calculated for all of the child's miscues (including insertions and omissions), they were converted to percentage scores by using two times the total number of the child's miscues as the denominator. Again this procedure allowed the student to achieve a score of 100 regardless of the number of miscues and it provided a means of evaluating the quality of a students' miscues rather than just counting the total number.

It is important to note that, in this study, miscues were not looked at as ends in themselves and, therefore, as negative aspects of a child's reading ability. Rather, they provided a means or a vehicle for observing the cueing strategies that each reader was using as he read. Consequently, it was imperative to evaluate how effectively the child was using each strategy by assessing the positive aspect of each miscue in relation to the expected response. To do this the researcher assessed on what percentage of his miscues the child effectively utilized each of the cueing strategies.

High syntactic acceptability occurred if a child read "John was shouting directly to Tom." instead of "John was shouting directions to Tom." Grammatically the miscue "directly" was acceptable even though it changed the meaning of the sentence. If a child read "Her wings were folded quietly and her sides." rather than "Her wings were folded quietly at her sides.", the miscue "and" was only acceptable with the part of the sentence prior to it and was, therefore, considered to be somewhat or partially acceptable. If in the sentence "The cries of many gulls added to the noise." a child read "noise" as "noisy", the miscue would be considered grammatically unacceptable.

Semantic Acceptability. Semantic acceptability referred to the degree of meaning that had been retained in the miscue which rendered it consistent with the author's intended meaning both within the sentence and across the passage. A miscue that occurred in a sentence which was both meaningful and acceptable in relation to prior and subsequent sentences in the text, was considered to have high semantic acceptability. For example, in the sentence "We had just never had any pets until Sven Olson decided he wanted one.", when students read Steve instead of Sven, the miscue was considered highly acceptable and given a score of two. If, however, a miscue was acceptable only within a particular sentence (and not within the context of the paragraph or whole passage) or if it was acceptable only with the sentence portion that came before or after it, the miscue was then considered to be only partially acceptable and given a score of one. A student who read "I looked up and heard my first view of Claribel." rather than "I looked up and had my first view of Claribel." has given a partially acceptable miscue because it was only meaningful within the first part of the sentence. Finally, the student who read "She was a small yellow care hanging very still in the air." rather than "She was a small yellow canary hanging very still in the air." has made a semantically unacceptable miscue and would, therefore, receive a score of zero for that miscue. Again, if the miscue was corrected it automatically received a score of two since the reader realized that it was not meaningful and regressed to correct, thereby exhibiting efficient use of the semantic cueing strategy.

The percentage of semantically acceptable miscues, like the syntactically acceptable miscues, was arrived at by using the student's total raw score for highly and partially acceptable miscues as the numerator and two times the total number of miscues as the denominator. Therefore, when one compares what the reader did with what it was possible for him to do, one gains insight into how effectively he was utilizing the semantic (and previously the syntactic) cueing strategy.

Discourse Processing Strategy Variables

The first step in constructing discourse processing strategy variables consisted of transcribing word for word the oral recall that each child gave following his reading of the passage. Each transcription was then divided into clausal units and mazes. A sample of how the transcribed recalls were coded into clausal information units is given in Appendix 4. The interrater agreement between the thesis supervisor and the researcher was 93.4% across six ratings using the Arrington Reliability Formula (Fiefel and Lorge, 1950). Once clausal units had been established, they formed the basis of subsequent coding in order to construct the Content and the Structure variables.

Content Variables. Four Content domain variables were constructed by allocating the clausal information units into one of the four following categories: (1) text specific; (2) text entailed; (3) text erroneous; and (4) text external. In order to assign the recall information units to one of the four categories, the story

"Space Pet" was first divided into clausal units and the clausal units given in the student recalls were then compared to those within the story text.

Although each of the four categories contained sub-categories as guides for the allocation of units into categories, for the purposes of this research only the four larger categories were used. This was necessitated because of the size of the case base and the already large number of variables included in the model. The interrater agreement for the allocation of units to categories was 93.7%.

Each clausal unit was given a count of one. The total number of units falling under each of the four categories then constituted the students' content scores. The categories are briefly described below and examples are given for the purpose of clarification.

Text Specific. This category included the verbatim recall of a single clausal unit from the original text or a paraphrase of the unit. Examples of clausal units from this category follow.

Direct recall of lexical items

Text: Claribel always got noisy.

Recall: Claribel always got noisy.

Substitution of pronouns

Text: That's why Claribel passed out.

Recall: That's why she passes out.

Synonymy of elements

Text: She came back to life at once.

Recall: She came back to life again.

Partial recall

Text: To our delighted surprise, she came back to life at once.

Recall: She came back to life at once.

Text Entailed. The information units recalled were either: (1) a synthesis of two or more units of information from the text; (2) a generalization or summary subsuming information from more than one unit in the text; or (3) an inference arrived at through logical reasoning or instantiation of ideas.

Summary/Generalization

Text: As far as I know there has never been a rule against pets in a space station. We had just never had any pets until Sven Olson decided he wanted one. None of us ever figured out why he chose the pet he did.

Recall: A fellow named Sven decided to take a pet into a space station.

Synthesis

Text: Today, if you should visit a space station, don't be surprised to hear a canary singing.

Recall: When you hear a canary up in a space station ...

Inference

Text: Just then Sven appeared at the door. In his hand lay a tiny bunch of yellow feathers with claws sticking up in the air.

Recall: He finally found the half-dead bird.

Text Erroneous. These units included text information which the reader had confused or combined in an erroneous way. Examples of erroneous information conveyed in the recalls are given below.

Errors in names

Text: "Where's Sven?" I asked. "He's looking for Claribel," someone answered.

Recall: Jim was looking for Claribel.

Incorrect information or incorrect substitution

Text: "Where's Sven?" I asked. "He's looking for Claribel," someone answered.

Recall: They were looking for Claribel.

Inaccurate summary or incorrect synthesis

Text: Claribel was put into a face mask. It was as large as an oxygen tent for her.

Recall: And they put her into an oxygen tent.

Faulty inference

Text: As far as I know there has never been a rule against pets in a space station. ... We couldn't be sure if we were breaking any rule having her there. But we liked her too much to take a chance on losing her. We had a little trouble hiding her when important guests came.

Recall: You are not allowed to have pets on the space station.

Text External. Recall units of external information included either information that was so general that it did not convey any specific information or was a convention of storytelling and oral recall. Examples of text external recall units are given below.

Vague generalizations

Text: During the night, part of an air line had frozen, and the alarm had failed to go off. Half a million dollars worth of engineering instruments had let us down.

Recall: One night half a million dollars of engineering parts (*or something like that*) had failed.

Story telling conventions

Text: No specific referents

Recall: And at the end of the story it says ...

or

That's all I can remember.

Structure Variables. Three kinds of Structure variables were constructed in an attempt to assess how readers in the sample were relating pieces of incoming information together. Each group of variables is discussed in turn.

Logical Connectives. Logical connectives provided information on how the reader was combining or joining together pieces of information both within and between clausal units. It was believed that this type of connective would provide insight into the logical relationships that the child was making as he read the passage. Each time a logical connective (conjunction) was encountered in the student's transcribed recall, it was allocated to one of eleven connective categories. Each connective was given a count of one and the total number of connectives within each category was summed to establish a connective score on that category for each student.

Conjunction This connective expressed the general relationship of joining together two or more ideas. The most common conjunction was "and".

Recall: They were on a space station and people used to visit them.

Disjunction Disjunction expressed the relationship of alternatives. The most common word used to express disjunction was "or".

Recall: They had to hide the canary or let the visitors find it.

Manner Connectives of this type expressed the mode or manner of an action or indicated with what an event was concerned. The most commonly used words to express the manner in which something occurred were "about", "with" and "like".

Recalls: Something was wrong with the air.
The story was about a canary in a space station.
She looked like she was dead.

Causality These connectives expressed the relationship of cause and effect. Common words denoting causality were "because", "then" and "so".

Recalls: Steve liked pets so he wanted one in the space station.
They gave her oxygen and then she came back to life.
They had to hide the bird because people came to visit.

Purpose Purpose indicated an intentional act or event that was carried out in order to obtain a particular result. Commonly used words to express purposive relationships were "to", "for" and "so".

Recalls: People used to visit them in the space station.
He was looking for the bird.
He went out so he could look for the bird.

Concession This relationship expressed the yielding of a point in an argument or the acknowledgement of an alternate situation. The most commonly used words to indicate concession were "but" and "however".

Recalls: They gave her oxygen but she kept on passing out.

They didn't hear her but she made a lot of noise.

He thought she was dead. However, he wasn't sure.

Contrast Connectives of this type expressed the relationship of divergence or differences between objects or actions. Words expressing contrast that were used were "same as" and "different from".

Recalls: Claribel woke him up every morning. It was the same as having a whistling alarm clock.

They gave her oxygen again. But this time was different from the last time because she stayed alive.

Condition Conditional connectives expressed the relationship whereby one thing limited or modified the existence of something else. These relationships are commonly known as "if-then" conditions. Words used to express conditional relationships were "if" and "if-then".

Recalls: If you ever hear a canary singing it means you have a double safety guard.

They didn't know if they were allowed to have a pet.

If the bird hadn't gotten sick then they would have all died.

Temporal disjunction One event happened either before or after another event. Words such as "before", "after", "then" were used to express this relationship. "Then" was used almost exclusively by the students in this sample.

Recalls: They took the pet. Then they realized that something was wrong with the air.

It was about a canary in a space station and after she died.

Where the words "and" and "then" appeared together as connectives (which they often did) they were considered to be one temporal disjunction on the grounds that "and then" was simply a child's idiomatic expression for a "then" connective.

Recalls: They searched all over and then Steve came back with a bunch of feathers in his hand. And then the doctor came and they put her in oxygen and then she came back to life.

Temporal conjunction An event happened at the same time as another event. The most commonly used words for this relationship were "when" and "while".

Recalls: They heard her singing when they got her.

When I looked up, I saw the canary.

She always peeped and whistled while the visitors were there.

Location Objects or events were placed in a spatial framework. The words "at", "in", "on", "to", "from" and "over" were most commonly used to indicate the location of an object or an event.

Recalls: It's about a canary at a space station.

They were on a space station.

The men in mines always took a canary with them.

If you ever go to a space station ...

He could hardly drag himself from the bed.

They put the oxygen mask over her.

Referential Connectives. Referential connectives provided information on how readers were relating the information they were currently recalling back to previous information they had already given. That is, referential connectives were words that were used throughout a recall that had an antecedent in the form of a noun or a clause which appeared earlier in the recall. They were believed to be another indication of how the reader attempted to organize the incoming bits of information into some kind of cohesive set of interrelated ideas. In other words, how did what the reader recalled at one given point in the recall relate back to what he recalled in the previous sentence or sentences?

As in the case of logical connectives, each time a referential connective was encountered in the student's transcribed recall, it was allocated to one of ten referential categories. Each referential connective was given a count of one and the total number of connectives within each category became the student's score for that type of connective.

Pro-form pronoun Personal, possessive, and demonstrative pronouns that stood for or referred back to a previous antecedent constituted the pro-form group.

Recalls: Steve, one of the men, liked pets so he wanted to take one.

The people were up in the space station. ... And they didn't know if they were allowed to have a pet.

Jim was looking for the bird and he came back with yellow feathers and claws in his hand.

Story referent pronoun This connective was like the pro-form pronoun but there was no antecedent for it in the student's recall. Rather the pronoun referred directly to a person or persons in the story itself and, therefore, integrated the information being conveyed with the story concepts rather than with the noun or clause just previously mentioned by the student.

Recalls: It was about a bird, a canary. And they were on a space station.

If you should ever visit a space station ...

The antecedent for the "they" and the "you" have not been referred to in the recall itself, only in the story.

Relative pronoun This connective included the relative class of pronouns and were generally used to introduce clauses.

Recalls: There was a fellah up the front who was sleepy.

It was about a canary and some men who tried to save it.

Complementizer A complementizer was a connective that introduced a noun complement.

Recalls: They realized that something was wrong.

If you visit a space station and a canary passes out you always know what it means.

Repetition A lexical item was repeated and was meant to refer to the same item previously mentioned.

Recalls: They were on a space station. ... So he wanted a pet to stay in the space station.

They gave her oxygen but she kept on passing out. So they gave her more oxygen.

Synonym One lexical item replaced another but was meant to refer to the same object or event. The substituted word was the same part of speech.

Recalls: Steve wanted a pet and he picked a canary. ... And they gave the bird more oxygen.

They gave the canary some good air but she passed out again. So they gave her more oxygen.

Class inclusion A noun introduced a subset of a class already mentioned or, conversely, named the class of a particular subset previously recalled.

Recalls: It was about a bird, a canary.

Sven, one of the men, liked pets.

Derivation Two lexical items shared the same semantic root and were usually the same part of speech. A derivation connective could have been derived from another part of speech (for example, from a verb) but the derivation must have been a noun.

Recalls: She sang a song.

When the miners used to go down in the mines ...

So he squawked and they had a hard time explaining the squawks and noises.

Inclusion A general word or phrase was used to refer back to and sum up a previous description of an event or happening.

Recalls: So he wanted a pet to stay in the space station and he thought it wouldn't do any harm.

And then they found out what had happened. (Previous text told of the air line freezing.)

Formal repetition A lexical item was repeated but it did not refer to the same object or event mentioned previously. Instead it introduced a new member of a class or a new concept associated with the repeated word.

Recalls: If you ever visit a space station and hear a canary singing ...

One of the men in the space station liked pets. ... And they realized that the men in the mines took a canary down.

Staging. Staging variables were constructed in an attempt to understand how the readers in the sample were ordering and/or organizing segments of the story into a meaningful whole which they later conveyed to the researcher during their oral recall. In order to observe this phenomenon, four variables were created: (1) new topics; (2) elaborations of topics; (3) elaborated topics; and (4) sequence of new topics. Each variable is described below following which is included a sample of the coding of one passage and the tabulation of scores.

New topics A topic was defined as the noun or personal pronoun that was the subject of the clausal unit. In order to be considered as a new topic, the topic had to be introduced as the subject of the clause of the first time in the recall.

NT NT
Recall: A bird was in the story. And the people they were up in a
old T
space station. And they wanted a pet.

A topic was considered new if it was introduced as a subject for the first time in a clausal unit appearing later in the recall even though it had been previously mentioned as the object in an earlier clause.

NT
Recall: (continuation of the example above) ... The space station
had trouble with air.

Clauses that contained completely incorrect information were not considered in the coding. However, if a name (as a topic) was confused but the remainder of the clause was accurate, the topic was included in the coding. The rationale for this was that incorrect information of this kind had been counted as erroneous information when the clausal units were categorized into one of the four Content variables.

NT
Recall: Jim went to look for Claribel.

Elaborations Elaborations were additional pieces of information that were given about new topics. These often occurred immediately following the new topic but they could also occur later in the recall. Completely inaccurate elaborations on a topic were not counted. (See example below).

Elaborated topics When a new topic was elaborated upon it was considered to be an elaborated topic which was a subset of the new topic.

Recall: And the $\overset{\text{NT ET}}{\underline{\text{people}}}$, they were up in a space station. And $\overset{\text{Elab}}{\underline{\text{they}}}$ wanted a pet and $\overset{\text{Elab}}{\underline{\text{they}}}$ didn't know if $\overset{\text{Elab}}{\underline{\text{they}}}$ were allowed.

Sequence The sequence variable was simply the count of the number of new topics that the reader had recalled in the same sequence as presented in the story or in an acceptable sequence such that the sequential development of the story was maintained. During the coding of the staging variables it was found that there were virtually no instances of incorrect sequencing. Hence, the sequence variable and the new topics variable were the same thing. The sequence variable was, therefore, abandoned since it added no new information to the study.

Example of the coding:

A $\overset{1}{\underline{\text{bird}}}$ was in the story./ And the $\overset{2}{\underline{\text{people}}}$ were up in a space station./ And $\overset{2e}{\underline{\text{they}}}$ wanted the pet/ and $\overset{2e}{\underline{\text{they}}}$ didn't know/if $\overset{2e}{\underline{\text{they}}}$ were allowed./ And $\overset{2e}{\underline{\text{they}}}$ heard him singing/when $\overset{2e}{\underline{\text{they}}}$ had him./ The $\overset{3}{\underline{\text{space}}}$ $\underline{\text{station}}$ had trouble with the air./ And the $\overset{1e}{\underline{\text{canary}}}$ went out one night/ and the $\overset{4}{\underline{\text{air}}}$ wasn't no good./ $\overset{1e}{\underline{\text{She}}}$ stopped breathing./ And then $\overset{2e}{\underline{\text{they}}}$ brang in the oxygen/and the $\overset{5}{\underline{\text{oxygen}}}$ went over the bird/and then $\overset{1e}{\underline{\text{she}}}$ came back to life./ And $\overset{2e}{\underline{\text{they}}}$ found out/that the $\overset{6}{\underline{\text{air lines}}}$ was frozen/ and the $\overset{7}{\underline{\text{air}}}$ had gone bad./

New topics (indicated by number only) = 7

Elaborations (indicated by e's) = 10

Elaborated topics (indicated by how many numbers from one to seven have e's with them) = 2

Sequence = 7 (All new topics were introduced in a sequence compatible with the story sequence).

Reliability and Validity

Since it was not possible to estimate the reliability and validity of the raw data items, the best that could be done was to consider previous studies conducted using the same intruments. The RMI instrument used to measure the graphic, the phonic, the syntactic and the semantic variables was based on considerable research in the field of reading. It has been widely used for over a decade and the concensus from both clinical use and research studies is that, although it is time consuming to use, it does give a good measure of a child's ability to use cueing strategies while reading. It would seem then, from past experience with the instrument, that it is highly reliable and valid in terms of what it claims to measure.

The instruments used for measuring the Content and Structure variables were virtually at the opposite extreme of the continuum. In the case of the Content variables, a variety of modifications of the present instrument have been used to assess the kind of information that students extract from print as they read. Studies done to date have used very small data bases (from twenty to forty) and have usually modified the instrument on logical grounds only, to suit the purposes of the particular study. As a result, no consistent findings have emerged that enabled the present researcher to utilize a "proven" instrument for assessing the Content domain.

As far as the researcher is aware, no studies have been conducted whereby the instrument for measuring the Structure variables has been used to assess how children were structuring or organizing the incoming information as they read. Forster (1978), however, used logical and referential connectives to assess whether differing the number of connectives contained within a passage affected the amount of information recalled by twenty average fourth grade readers. Fagan (1978b) used the instrument to assess the use of connectives and staging in nine, ten and eleven year olds oral language. This study, then, in the area of assessing Content and Structure had little empirical evidence to use in selecting and/or modifying an instrument for measuring the two domains.

CHAPTER IV

DATA REDUCTION

This step in the study was undertaken in order to reduce the number of independent variables by constructing weighted composites from the thirty-two observed variables contained within the raw data. This was done for two reasons: (1) to convert the data into theoretically more meaningful constructs; and (2) to render the data more manageable statistically.

One of the biggest problems in educational research stems from the fact that many of the concepts we want to work with are not directly measurable. In the case of this study, how does one "get at" a reader's ability to use cues from his background knowledge and language fluency in order to help him understand what he read? Or, similarily, how does one "see" what the reader was selecting to focus on from the printed pages and how he then organized what he had selected in order to make the print comprehensible? Since these are all mental processes, such hypothetical concepts and unobservable constructs, or latent variables, cannot be directly observed or measured. However, "a number of variables can be used to measure various aspects of these latent variables more or less accurately" and, therefore, can be regarded as indicators of the concepts or constructs under investigation (Jöreskog, 1976, p.53). Each indicator has a relationship with the latent variable but if one indicator alone is used to measure the concept a biased measurement is the result. By using several indicators of each latent variable, a more accurate assessment of the concept is obtained. Since one then ends up with several variables measuring the two or three constructs thought to be associated with the organizing ability or a cue selection ability, the question arises as to how to disentangle the complex interrelationships inherent in such data into their major and distinct regularities.

Factor analysis can simultaneously manage over a hundred variables and, based upon the correlation coefficients between the interrelated observed variables, extracts groups of variables that cluster together to either confirm *a priori* constructs based on the theory or to produce constructs *ex post facto* where predictions as to the underlying structure of the data were not made. The cluster consists of variables that correlate highly with one another and have comparatively low correlations with variables in other clusters. Hence, the data become more meaningful theoretically.

The second reason for using a factor analytic approach is to reduce the number of independent variables used as predictors of reading comprehension such that stable model parameters could be estimated. The estimation of the relationships of models of the kind formulated in this study involves the estimation of mathematical equations which are probabalistic rather than deterministic. In practice this means that if variables are added to or taken away from an equation representing the model, the parameter estimates will change. By the same token the estimates of any equation will also change with different samples. Thus, the researcher is constantly confronted with the problem of the reliability of the results for the estimates of the model. Questions arise such as: (1) how great is the sampling fluctuation; (2) how sensitive are the estimates to model misspecification;

that is, to the erroneous inclusion or omission of a variable or variables?

Unfortunately, not a great deal is known about the reliability of the estimates of regression equations due to the above problems (Kerlinger & Pedazur, 1973, p.446). It is known, however, that the variability of regression estimates is a function of three factors (Pindyck & Rubinfeld, 1976, p.22): (1) the random error which consists of two parts, measurement error and stochastic error which is usually due to the erroneous omission of explanatory variables; (2) the sample size or more specifically, the degree of freedom of the sum of squares error; and (3) multicollinearity.

Random error can be reduced by improving the precision of measurement and by improving the design or specification of the model. The design of the model, however, has been established for this study and, therefore, is not manipulable at this stage. In fact the purpose of this study was to test an integrated theory of reading in order to be able to justify improved designs in the future. The matter of the precision of measurement is, however, under the control of the investigator. This was managed through the technique of latent variable construction based on several observed variables representing theoretical concepts. The procedure is discussed above.

The variability of the parameter estimates is also attributable to sample size; the larger the sample the less the variability. Most researchers are advised to use as large a representative sample as possible. Thus, Kerlinger and Pedazur (1973, pp.446-447) suggest that "any multiple regression analysis, and especially those with many independent variables, should have at least 100 subjects, preferably

200 or more," because "the larger the sample size the more precise the statistical estimate."

It is not, however, the absolute number of cases that is important, but rather the number of cases in relation to the number of independent variables. The object of the exercise is to minimize sampling error. In the context of a discussion of multivariate analysis, Nunnally (1978, p.421) argues that "a good rule is to have at least ten times as many subjects as variables", whereas, in contrast Kerlinger and Pedazur (1973, p.282) state "some authors recommend that the ratio of independent variables to sample size be at least thirty subjects per independent variable." In the case of the present study, an attempt was made to try to come up with a compromise between the two suggestions by : (1) including approximately 100 students in the sample; and (2) by restricting the number of independent variables in the model through the use of latent or composite variable construction based upon the clustering of observed variables.

Third, the problem of multicollinearity as a source of variability in regression estimates was dealt with by constructing composites that contained most of the collinearity within themselves. The composites representing the constructs under investigation would then be relatively independent of one another within the model.

Cueing Strategy Composite Construction

The correlation matrix presented in Table 1 clearly indicated that a great deal of overlap or multicollinearity existed between some of the variables. A coefficient of .925 between the graphic and the phonic variables and a coefficient of .752 between the syntactic and

TABLE 1

Correlation Matrix, Means, and Standard Deviations for the Cueing Strategy Variables (N = 94)[a]

Variables	GR	PH	SYN	SEM	Mean	SD
GR	1.000	94	94	94	68.97	13.24
PH	.925	1.000	94	94	64.37	13.08
SYN	-.168	-.173	1.000	94	58.83	12.16
SEM	-.155	-.164	.752	1.000	63.64	17.12

[a] Correlation coefficients below the diagonal; number of cases used in the construction of the correlation coefficient above the diagonal. Key to the variable mnemonics: GR = percentage of miscues graphically similar; PH = percentage of miscues phonetically similar; SYN = percentage of miscues syntactically acceptable; SEM = percentage of miscues semantically acceptable.

semantic variables leads one to believe that, in fact, graphic and phonic cueing strategies were so closely related that they were not separate variables but together formed a grapho-phonic strategy. Similarly, the syntactic and semantic variables appeared to both be part of some underlying concept that incorporated the reader's ability to use syntax and semantics in an integrated manner.

Such coefficients were not unexpected since we know that readers learn to use letter-sound (grapho-phonic) relationships to assist them in decoding words. We also know that the semantics or meaning of a sentence is not likely to be understood if the syntax or grammar does not sound like real language. Nor was it surprising to find that syntax and semantics actually had low negative correlations with graphics and phonics. Experience by professionals working with children learning to read indicates that many readers are overly concerned with accurate letter-sound relationships. Such an obsession with accuracy often leads the child to believe that as long as he reads as accurately as he can, that it matters little whether what he is reading sounds right and makes sense to him. Those readers who put language sense and meaning first are usually those who are least concerned that their reading be an exact (or very close to exact) rendition of the text before them. Discrepancies between what the author has "said" and the child's interpretation of the print only worry this type of reader when his rendition fails to make sense and he wanders too far from what the author has implied; hence, the low negative correlation. This seems to imply that the relationship between graphics/phonics and syntax/semantics is, at best, very low and if important at all, is important in a negative direction.

Since the correlation coefficients bear out the relationships observed by professionals in the reading field, one could reasonably hypothesize that two factors would emerge when all four variables are factor analyzed. Because the factor analysis was intended to be confirmatory, as opposed to exploratory, two factors were called for using an orthogonal rotation since, from experience and from a theoretical basis, if a grapho-phonic and a syntactic-semantic factor emerged they should be independent of one another.

Support for two factors was found in the results presented in Table 2. The factor matrix clearly indicated two factors and there were two eigenvalues greater than one. The problem of the number of factors to be extracted and subsequently rotated has no general solution. Theoretical considerations in a confirmatory analysis should provide the most important direction for extracting factors but Kaiser's "eigenvalue-one" rule is also often applied routinely as a solution to the problem. This rule of thumb suggests that the number of factors be equal to the number of eigenvalues greater than one (Kaiser, 1960, 1970). It should be remembered that this is just a rule of thumb that works more often than not and what one really wants is some compromise or balance between the adequacy of the factors in accounting for the variance among the variables and the interpretability of these factors in substantive terms.

An examination of the patterns of loadings in Table 2 bears out the argument advanced earlier in connection with the dimensions of cueing strategies. Factor one was clearly a Grapho-Phonic factor representing variability in the use of letter-sound relationships to gain meaning from print. Factor two was a Syntactic-Semantic

TABLE 2

Cueing Strategies: Factor Matrix from Orthogonal Rotation (VARIMAX) and Factor Score Coefficients

Items	Factor Matrix			Factor Score Coefficients	
	I	II	h^2	I	II
GR	.957	-.092	.925	.505	.044
PH	.957	-.100	.925	.505	.028
SYN	-.092	.863	.752	.045	.500
SEM	-.080	.863	.751	.047	.498
Eigenvalues	2.049	1.304			

Key to the mnemonics: GR = percentage of miscues graphically similar; PH = percentage of miscues phonetically similar; SYN = percentage of miscues syntactically acceptable; SEM = percentage of miscues semantically acceptable.

factor[1] and reflected the way in which the readers varied in their use of language patterns and experiential background to assist them in interpreting the print before them. The factor score coefficients in Table 2 were then used to construct two latent variable composites. The general formula used to construct the composites was:

$$F_1 = W_1Z_1 + W_2Z_2 + \ldots W_kZ_k$$

where W_k = the factor score coefficients and

Z_k = the standardized values of the variables.

Thus Z_1 = (Var 1 - mean of Var 1)/ the standard deviation of Var 1.

Content Variable Composite Construction

During the coding of the data it was noted by the researcher that the staging variables (NTOP, ETOP, ELAB) seemed to be measuring the same kind of underlying construct as the Content variables (TSPEC, TENT, TERR, TEXT). On these grounds it was decided to collapse the two sets of variables into one and to do a principal component analysis since there was only one eigenvalue greater than one. Scrutiny of the correlation matrix in Table 3 indicated that, indeed, there appeared to be a great deal in common between the staging variables and the text specific and text entailed variables of the Content domain. Text erroneous and text external information from the Content domain had much lower correlations with the staging variables and, therefore,

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1. Throughout the remainder of the study the initial letters of the latent variables are capitalized; for example, Grapho-Phonic, Syntactic-Semantic, Content, Description and so on. The initial letters of observed variables are not capitalized; for example reading comprehension, graphic similarity, text specific and so on.

TABLE 3

Correlation Matrix, Means, and Standard Deviations for Content and Staging Variables (N = 94)[a]

Variables	TSPEC	TENT	TERR	TEXT	NTOP	ETOP	ELAB	Mean	SD
TSPEC	1.000	94	94	94	94	94	94	4.54	4.76
TENT	.714	1.000	94	94	94	94	94	8.70	5.63
TERR	.303	.269	1.000	94	94	94	94	2.93	2.49
TEXT	.458	.387	.266	1.000	94	94	94	1.67	1.86
NTOP	.844	.779	.294	.513	1.000	94	94	5.70	3.27
ETOP	.814	.822	.328	.424	.817	1.000	94	3.14	1.94
ELAB	.858	.920	.395	.424	.764	.845	1.000	9.11	7.56

a. Correlation coefficients below the diagonal; number of cases used in the construction of the correlation coefficient above the diagonal. All coefficients are statistically significant at the .05 level of confidence. Key to the mnemonics: TSPEC = text specific information; TENT = text entailed information; TERR = text erroneous information; TEXT = text external information; NTOP = number of new topics; ETOP = number of elaborated topics; ELAB = number of elaborations.

could constitute a second domain.

The results of the principal component analysis is shown in Table 4. With the exception of text erroneous and text external, all of the variables loaded high as a single factor. Theoretically, these two variables were quite distinct from the other variables in the composite since one indicated erroneous information that the reader had constructed as a result of reading the text and the other indicated a vague conceptualization of information in the text or what is often called a story telling convention. On these grounds it was decided to extract two orthogonal factors from the data to see if two distinct factors existed.

The results in Table 4 indicated that there were not two distinct factors in the data. The factor loadings in the factor matrix for the two-factor solution indicated that when an attempt was made to force the variables into two factors the factor loadings became unstable; that is, they began to shift in such a way that they became uninterpretable given what the variables were attempting to measure. The results on the correlation matrix were again considered and since the staging variables did not appear to be adding any new information over-and-above the information given by the Content variables, it was decided to eliminate the staging variables. It was believed that they were measuring the same thing and in virtually the same way as the text specific and text entailed variables from the Content domain. Note the high correlations between the TSPEC, TENT variables and the ETOP, ELAB variables. They were, therefore, considered to be redundant.

Since there was only one eigenvalue greater than one for the combined Content and staging variables, it was decided to use a

TABLE 4

Content and Staging Composites: Principal Component and Two-Factors Solutions[a]

	Principal Component Solution		Two-Factor Solution Factor Matrix		
Items	I	h^2	I	II	h^2
TSPEC	.892	.795	.583	.683	.807
TENT	.878	.771	.836	.400	.858
TERR	.363	.132	.236	.279	.133
TEXT	.496	.246	.208	.521	.315
NTOP	.890	.792	.519	.771	.863
ETOP	.909	.827	.686	.585	.814
ELAB	.942	.898	.881	.451	.979
Eigenvalues			4.508	0.263	

a. Key to the mnemonics: TSPEC = text specific information; TENT = text entailed information; TERR = text erroneous information; TEXT = text external information; NTOP = number of new topics; ETOP = number of elaborated topics; ELAB = number of elaborations. In the two-factors solution the factor matrix was from the orthogonal (VERIMAX) rotation.

principal component analysis on the Content variables by themselves. Table 5 gives the results of the analysis. The factor score coefficients were then used to construct a latent variable composite using the same equation as for the cueing strategy composites.

Structure Variable Composite Construction

Since the staging variables were eliminated due to redundancy, the Structure variables consisted of two sets of connectives; namely, logical connectives and referential connectives. During the course of the coding it was noted that some of the connective types were used so seldom by the students in the sample that they could not realistically be called variables. The cut-off point for the purpose of eliminating the non-variables was established as a result of the univariate analysis. Six variables, four logical connectives and two referential connectives, were eliminated because the mean for those variables fell below .5. This meant that, on the average, fewer than half of the sample used those connectives only once. The logical connectives that were eliminated included disjuntion, concession, constrast, and condition while the referential connectives excluded from further analyses were the relative pronouns and derivations.

This segment of the study may be thought of as exploratory since the researcher was unable to hypothesize which connective variables would cluster together to form factors. It was believed that there were perhaps three types of logical connectives, each with an increasing level of complexity; namely, descriptive, explicative and perceptual. However, no similar categorization was postulated for referential connectives. At best it was thought that by examining the connectives

TABLE 5

Content Variable No. 1: Principal Component Analysis[a]

Items	Principal Component	h^2	Factor Score Coefficients
TSPEC	.871	.759	.389
TENT	.836	.699	.373
TERR	.543	.295	.242
TEXT	.699	.488	.312

a. Key to the mnemonics: TSPEC = text specific information; TENT = text entailed information; TERR = text erroneous information; TEXT = text external information.

used during an oral recall of a story, an indication of how the child was organizing incoming information could be ascertained.

An examination of the correlation matrix in Table 6, likewise, did not give any clear indication of how the variables might cluster. While it is true that some variables correlated more highly than others, there was no clear pattern emerging as there had been with the cueing strategy variables. In an attempt to get a reasonable solution to the problem, it was decided, first of all, to factor analyze each set of connectives (logical and referential) since they seemed to be theoretically different in kind. Since this was an exploratory analysis no restrictions were placed on the number of factors to be extracted from each set of variables. Rather any factor with a root or eigenvalue greater than zero was to be included. Orthogonal solutions were used since the researcher was attempting to delineate principal factors that were independent of one another.

Since this part of the factor analysis was exploratory in nature, principal factoring without iteration was used. Further, the main diagonal of the correlation matrix was not altered which meant that the principal components extracted were exact mathematical transformations of the original variables. This method of factoring did not require any assumptions about the general structure of the variables which is characteristic of an exploratory type of factor analysis.

This procedure is in contrast to the principal factoring with iterations that was used for the confirmation of the two cueing strategy dimensions. When using iterations, the main diagonal elements of the correlation matrix are automatically replaced with communality estimates each time an iteration is carried out.

TABLE 6

Correlation Matrix, Means and Standard Deviations for Fifteen Connective Variables[a]

Variables	CONJ	MANN	CAUS	PURP	TDIS	TCON	LOC	PROF	STRF	COMP	REP	SYNM	CINC	INCL	FREP	Means	SD
CONJ	1.000															5.05	4.19
MANN	.632	1.000														2.34	2.19
CAUS	.411	.419	1.000													1.27	1.17
PURP	.582	.511	.376	1.000												2.32	2.41
TDIS	.487	.507	.537	.436	1.000											2.12	2.39
TCON	.386	.360	.436	.525	.343	1.000										1.22	1.55
LOC	.619	.581	.431	.503	.541	.547	1.000									2.71	2.16
PROF	.745	.531	.457	.597	.610	.421	.631	1.000								8.52	6.66
STRF	.102	.397	.529	.418	.394	.487	.378	.272	1.000							3.48	3.91
COMP	.482	.350	.339	.489	.328	.306	.413	.424	.317	1.000						0.70	1.05
REP	.743	.644	.436	.636	.607	.534	.682	.662	.287	.406	1.000					3.11	3.37
SYNM	.551	.454	.383	.337	.453	.324	.474	.433	.373	.183	.521	1.000				0.62	0.86
CINC	.687	.426	.314	.515	.413	.359	.420	.543	.414	.462	.488	.418	1.000			0.94	1.16
INCL	.476	.546	.355	.382	.515	.325	.363	.535	.284	.461	.542	.353	.316	1.000		1.51	1.43
FREP	.387	.432	.384	.343	.310	.428	.430	.288	.324	.421	.388	.392	.295	.258	1.000	1.00	1.54

a. Mnemonics: CONJ=logical conjunction, MANN=logical manner, CAUS=logical causal, PURP=logical purpose, TDIS=logical temporal disjunction, TCON=logical temporal conjunction, LOC=logical location, PROF=referential proform pronoun, STRF=referential story pronoun, COMP=referential complementizer, REP=referential repetition, SYNM=referential synonym, CINC=referential class inclusion, INCL=referential inclusion, FREP= referential formal repetition.

When each set of connective variables was factor analyzed, the results were ambigious. If the eigenvalue greater than one criteria was used each set of variables should have had only one factor. However, the factor loadings were not at all clear cut. In each case three or four variables loaded on the first factor and the others formed singletons or doubletons. Since the same thing happened with both sets of variables, it was decided to collapse the two sets into one set and to proceed from there in trying to extract factors, again using the roots greater than zero criteria.

The first analysis indicated that there should probably be two factors based upon the eigenvalues. When the rotated factor matrix was considered together with all of the eigenvalues to ascertain where the biggest drop in the amount of variance occurred, it was decided to eliminate all singleton and doubleton factors on the right hand side of the matrix and to rerun the analysis to extract six factors. Factor six was a singleton and, therefore, eliminated and a five factor solution was attempted.

In the five factor analysis, Factor 5 was a singleton; it was, therefore, eliminated and a four factor solution called for. Factor 4 proved to be a doubleton but Factors 1, 2 and 3 were beginning to cluster. Consequently, Factor 4 was dropped and a three factor solution attempted. The results of the three factor solution were accepted for three reasons: (1) the variables clustered with no singletons or doubletons; (2) the three factors were interpretable; and (3) three eigen values were greater than one. On these grounds, a compromise was made and the results of the three-factor analysis is presented in Table 7.

Factor 1 was a Descriptive factor representing a simple joining together of what occurred in the story. The connectives included in this factor were conjunction, manner, temporal disjunction, location, pro-form pronoun, synonym, repetition and inclusion. Ideas were strung together in a simple recall manner by the use of the conjunction "and" and the temporal disjunction "then". Other Descriptive connectives told how and where events occurred. For example, the manner connective "with" was often used to describe Sven after he had found the bird -- "He came back *with* Claribel on his hand." A location connective "in" often described where the people in the story were -- "They were up in a space station."

The referential connectives in factor one indicated that more description about a person or an event was about to occur. For example, through the use of the pro-form pronouns "he", "she" or "they", the subjects of the study kept adding bits of information about a previously mentioned person(s). Or sometimes they simply repeated the name or used a synonym for the word and then gave another piece of information. Through the use of an inclusion connective, the children summed up information on an event and then added additional information about the event. For example, a child may have already told about the air line freezing in the space station. He then went on to say, "*This problem* made the bird pass out and the men act very sleepy."

Factor 2 was an Association factor which was made up of three connectives; purpose, complementizer, and class inclusion. It differed from the Descriptive factor in that two pieces of information were related to each other in an associative manner rather than one idea

TABLE 7

Connectives Variables: Factor Matrix from Orthogonal Rotation (VARIMAX) and Factor Score Coefficients[a]

	Factor Matrix				Factor Score Coefficients		
Items	I	II	III	h^2	I	II	III
CONJ	.649	.572	.169	.776	.127	.189	-.155
MANN	.657	.299	.284	.602	.203	-.057	-.019
CAUS	.422	.037	.676	.637	.066	-.262	.371
PURP	.374	.618	.305	.614	-.082	.297	-.001
TDIS	.738	.090	.306	.647	.321	-.259	.019
TCON	.199	.350	.656	.592	-.171	.074	.347
LOC	.532	.407	.375	.590	.070	.060	.054
PROF	.715	.474	.098	.745	.219	.100	-.202
STRF	.169	.166	.778	.661	-.152	-.087	.479
COMP	.105	.777	.232	.668	-.278	.537	-.019
REP	.731	.425	.211	.760	.219	.032	-.115
SYNM	.653	.002	.369	.562	.289	-.311	.103
CINC	.354	.638	.195	.571	-.074	.343	-.078
INCL	.630	.295	.096	.493	.235	-.012	-.146
FREP	.142	.333	.600	.491	-.185	.093	.325
Eigenvalues	4.081	2.738	2.580				

a. Key to the mnemonics: CONJ = logical conjunction, MANN = logical manner, CAUS = logical causal, PURP = logical purpose, TDIS = logical temporal disjunction, TCON = logical temporal conjunction, LOC = logical location, PROF = referential proform pronoun, STRF = referential story pronoun, COMP = referential complementizer, REP = referential repetition, SYNM = referential synonym, CINC = referential class inclusion, INCL = referential inclusion, FREP = referential formal repetition.

simply being followed by another. That is, these connectives associated the event with the reason for the event. The word "to" was a commonly used purpose connective and was frequently used to tell why the people on the space station did what they did. One example was, "Sven went out to look for Claribel."

The complementizer connective most often seemed to be used to associate a person with what he said, knew or thought. For example, many students said something similar to "He said that she wasn't dead." or "The Doctor didn't think that the canary was dead." Through the use of the class inclusion connective the students associated information they were giving, which was about a subgroup, with the larger group to which it belonged. Or, conversely, they associated the larger inclusive group they were discussing with one of its subgroups. One child said near the beginning of his recall, "Some men were up in a space station." Later he recalled the following, "Jack, the man who was the cook and the doctor ...". Here the child had made the association between a particular man and the large group of men of which he was a part. When another child said, "One day Sven got a little yellow canary because he liked pets." he was associating the larger group, pets, with the subgroup canary.

Factor 3 was an Integrative factor and consisted of four connectives; causality, temporal conjunction, story referent and formal repetition. The Integrative factor would seem to be the most complex of the three factors in that the reader had to perceive interrelationships between ideas rather than just stringing together or making the association between two ideas.

In a sense, then, the use of Integrative connectives required a more abstract or complex type of processing than did the use of connectives in the other two factors. The use of causality connectives clearly indicated that the reader had integrated many pieces of information from the story and from his own experiential background in order to make a statement like, "The canary passed out because she did not get enough air when the airline froze." Nowhere in the story did it actually tell why the canary passed out. The reader must have made the inference from what was said in association with his already existing knowledge.

The temporal conjunction connective most frequently used was "when". Here again the reader had to integrate several pieces of information to come up with a statement like, "When Sven finally came back with the bird ...". The story referent connective indicated an integration of information between the actual characters in the story and the pronouns used to represent them in the recall. No intermediary reference was made to them at the beginning of the story recall and, therefore, everytime a student said "they" or "she" which referred directly back to a person in the story, the student had to be integrating all of the pieces of information about that person with his use of a pronoun to represent the person in his recall.

Finally, the connective formal repetition represented an integration of information because before the reader could use a noun in this manner he had to understand the relationship between the concept implied by the word when he first used it and the concept implied by the word when he used it again but in a different context. For example, almost all of the students talked about the canary passing out in the space station. Some readers also talked about the fact that when miners take a canary down into the mines, it acts as a warning when the air isn't right. Here the same word was repeated but it did not represent the same canary nor the same situation. Yet in order to make the relationship between the canaries, the child had to understand the interrelationship between the canary passing out in the space station and the use of canaries in mines.

Once the three factors had been extracted the factor score coefficients in Table 7 were used to construct three latent variable composites.

CHAPTER V

FINDINGS I: ESTIMATION AND DISCUSSION OF BASIC MODELS

This section of the study deals with the estimation and discussion of: (1) the cueing strategy model; (2) the discourse processing strategy model; and (3) the relationship between these two basic models. The chapter begins with a correlation matrix for all of the variables in the models because it is on the basis of the coefficients in this matrix that all other analyses were conducted. Table 8 presents the correlations, each of which was based on the maximum number of cases for which data were available; the case base for each correlation appears in the upper triangle of the table. A series of regression analyses was then used to identify the relative effects of the sets of predictor variables within each model on reading comprehension as well as the effects of cueing strategy variables on discourse processing variables.

Several variables in the correlation matrix are unmeasured variables whose nature was determined by factor analytic techniques. GP, SS CONT2, DESCR, ASSOC, INTEG and CONNTECT (which will be discussed later) are all factor composites or latent variables and have a mean near zero and a standard deviation of about one. The means of such composites have no real meaning because they are composed of added weighted scores of the variables underlying the construct. They are, however, treated as measured variables in subsequent analyses.

To get from the basic correlation data in Table 8 to the

TABLE 8

Correlation Matrix, Means, and Standard Deviations for Cueing Strategies, Discourse Processing Strategies and Reading[a]

Vars.	GP	SS	TSPEC	TENT	TERR	TEXT	CONT2	DESCR	ASSOC	INTEG	CONNECT	RDGCOMP
GP	1.000	94	93	93	93	93	93	93	93	93	93	84
SS	-.065	1.000	93	93	93	93	93	93	93	93	93	84
TSPEC	-.059	.256	1.000	94	94	94	94	94	94	94	94	84
TENT	.049	.325	.714	1.000	94	94	94	94	94	94	94	84
TERR	.127	-.087	.303	.269	1.000	94	94	94	94	94	94	84
TEXT	.119	.091	.458	.387	.266	1.000	94	94	94	94	94	84
CONT2	.034	.246	.894	.881	.567	.467	1.000	94	94	94	94	84
DESCR	-.071	.104	.645	.572	.451	.321	.704	1.000	94	94	94	84
ASSOC	.090	.110	.327	.425	.352	.435	.457	-.027	1.000	94	94	84
INTEG	.060	.252	.424	.477	-.075	-.020	.399	-.002	-.117	1.000	94	84
CONNECT	.033	.277	.866	.896	.476	.464	.966	.698	.455	.482	1.000	84
RDGCOMP	-.136	.596	.271	.390	-.226	.143	.238	.030	.178	.325	.312	1.000
Means	.000	.000	4.543	8.704	2.956	1.670	-.000	-.002	.017	-.001	-.001	45.53
SDs	.979	.929	4.760	5.632	2.494	1.857	1.004	.998	.952	.999	.999	9.13

a. Correlation coefficients below the diagonal; number of cases used in the construction of the correlation coefficient above the diagonal. The underlined coefficients are not significantly different from zero at the .05 level of significance. Key to the variable mnemonics: GP = Graphophonic cueing strategy; SS = Syntactic-Semantic cueing strategy; TSPEC = text specific information; TENT = text entailed information; TERR = text erroneous information; TEXT = text external information; CONT2 = information content; DESCR = Descriptive dimension of the connectives factor; ASSOC = Association dimension of the connectives factor; INTEG = integration dimension of the connectives factor; CONNECT = single dimension of the connectives variable; RDGCOMP = reading comprehension.

estimation of the cueing strategy and discourse processing strategy models, a series of regression procedures was used for both measured and constructed variables. The results of each step in the analyses as well as the discussion and subsequent decisions concerning further analyses are dealt with in turn.

The Cueing Strategy Model

The cueing strategy model was outlined in Chapter III and is presented diagrammatically in Figure 6. Since it was found during the factor analysis that two factors emerged from the cueing strategy variables, hypotheses 1A and 1B had to be reworded slightly to read as follows.

Hypothesis 1A: The greater the proficiency on the Grapho-Phonic strategy the lower the reading comprehension score, when taking into account the effects of the Syntactic-Semantic strategy.

Hypothesis 1B: The greater the proficiency in the Syntactic-Semantic strategy the higher the reading comprehension score, when taking into account the effects of the Grapho-Phonic strategy.

These hypotheses were tested using standardized partial regression coefficients (standardized betas). The utility of this procedure lies in the fact that the effect of the Grapho-Phonic strategy may be calculated relative to the effect of the Syntactic-Semantic strategy; that is, with the effects of Syntactics-Semantics partialed out. The results of the regression analysis for the cueing strategy model are presented in Table 9.

Neither the standardized beta for the Grapho-Phonic strategy (-.098) nor the correlation coefficient between Grapho-Phonics and

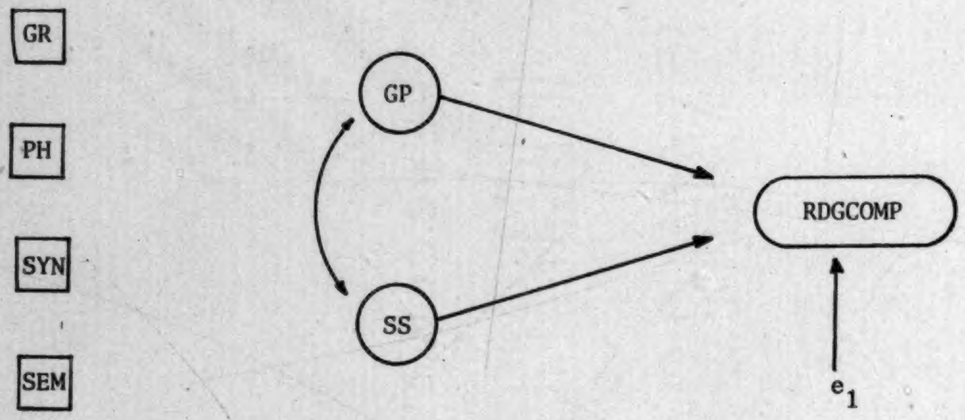

FIGURE 6. Specified Relationships in the Cueing Strategy Model[a]

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[a] Note: the parameters of the outer relationships (factor score coefficients) are presented in Table 2. The residuals on the cueing strategy variables = $\sqrt{1 - h^2}$ (see Table 2 for h^2 values). The parameters of the inner relationships (standardized betas and the RDGCOMP residual) are presented in Table 9. e_1 = residual = $\sqrt{1 - R^2}$.

TABLE 9

Cueing Strategy Estimates: Structural Coefficients, R-Square, and F-ratio[a]

Independent Variables	Dependent Variable: RDG COMP				
	Simple Correlation	Regression Coefficients	Standardized Reg. Coeffs.	F-ratio	p
GP	-.136	-.9135	-.098	1.217	ns
SS	.596	5.7899	.589	44.063	.000
Constant	45.5273				
R-square	.3458				
Residual	.809				

a. The underlined simple correlation coefficient is not significantly different from zero at the .05 level of significance. Key to the variable mnemonics: GP = Graphophonic cueing strategy; SS = Syntactic-Semantic cueing strategy; RDGCOMP = reading comprehension.

reading comprehension (-.136) were significant; whereas, the standardized beta for the Syntactic-Semantic strategy was .589 and significant beyond the .001 level. Hypothesis 1A was rejected since the Grapho-Phonic strategy seemed to have virtually no effect on reading comprehension in the presence of the Syntactic-Semantic strategy. What little effect it did have was, as hypothesized, negative but the coefficient was so low that, substantively, a child's proficiency in the use of letter-sound relationships had no effect on his ability to comprehend when taking into consideration the effect of the use of the Syntactic-Semantic strategy.

Hypothesis 1B was accepted since the standardized beta coefficient between reading comprehension and the use of the Syntactic-Semantic cueing strategy was substantial and highly significant even when taking into account the effect of the use of the Grapho-Phonic strategy. This indicated that, for this sample at least, what really made the difference between readers in their ability to comprehend was their facility at using what they knew about the flow of language together with their background of experiences in order to assist them in interpreting print. Their facility with letter-sound relationships had virtually no effect on their comprehension scores. Perhaps this was due to the fact that by grade four the use of letter-sound relationships had been so well established that few children in this sample had problems using such relationships whenever necessary to assist them in decoding words. Generally, a heavy emphasis is placed on teaching such decoding skills in the primary school years with less emphasis placed on assisting children to learn to use syntactic and semantic skills to their advantage. Despite this fact, for this grade four group, those readers who had learned, somehow, to capitalize on their language ability together with what they already knew, were those children who had a decided advantage in their ability to comprehend as they read.

One other point should be made. It is conceivable that if the study had been conducted on a grade one or grade two class, when young children are just learning to read, the results may have been quite different. At that point in time, young readers are not usually as proficient in decoding skills as are grade four children who have by then become so well steeped in such skills that decoding has become more or less automatic with the result that the older child heads more in the direction of reading as a means of learning. Undoubtedly, the Syntactic-Semantic strategy would still have a profound effect on young readers' comprehension ability, but it is likely that the Grapho-Phonic strategy would have exhibited a much stronger influence.

The Discourse Processing Strategy Model

The analysis for the discourse processing model was much more problematic than for the cueing strategy model because the measured variables for the Content domain (text specific, text entailed, text erroneous and text external) did not form two distinct factors; rather they emerged as a single composite principal component factor which was not particularly meaningful. If a regression analysis between the single composite and reading comprehension had been done the results would, of course, have simply been a correlation coefficient. Therefore, an alternate strategy was adopted. A regression analysis between reading comprehension and the four measured variables was conducted on the grounds that the researcher was particularly interested in the effects of the use of text specific and text entailed information given by the students as indicators of the kind of information that the readers extracted and used to reconstruct the writer's message. When these categories of reader information were included in a single factor composite it became impossible to ascertain how much effect each one had on the ability to comprehend when controlling for the use of the other categories.

The analysis for the second domain of the discourse processing model was straight forward since the fifteen connective variables representing the Structure domain factored into three distinct and interpretable composites. A regression analysis between reading comprehension and the three factors was then a viable procedure for estimating the effects of each of the underlying structures (Description, Association and Integration) on the dependent variable.

The Content Sub-Model

As indicated in Chapter III the Content Sub-Model dealt with the effects of the four kinds of information extracted from print on reading comprehension. The model is represented diagrammatically in Figure 7. It was hypothesized on the basis of the theory that those students who were trying to memorize much of what was in the text (as represented by the text specific recall category) would have lower comprehension ability than those students who were attempting to incorporate the new information into their old or already existing frame of background knowledge. As a result, the latter type of student would reproduce a recall that contained a large proportion of inferred

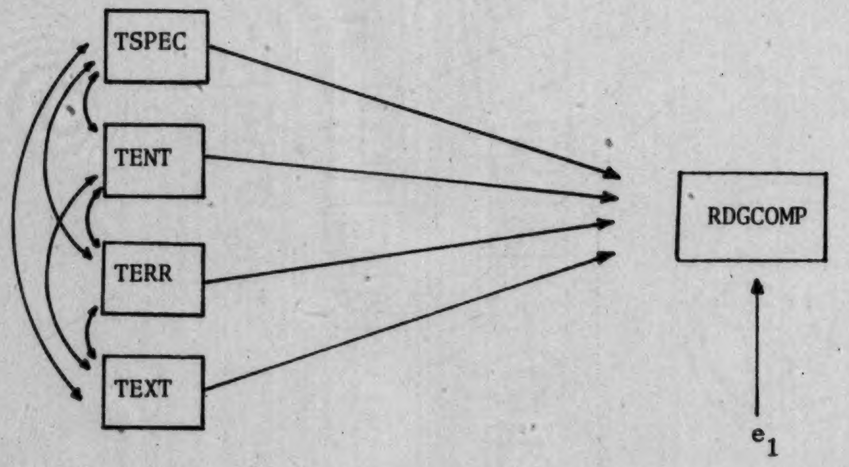

FIGURE 7. Specified Relationships in the Content Sub-Model[a]

and summarized, or reconstructed information as represented by the text entailed category of recall. In addition, it was hypothesized that the more erroneous (text erroneous) and vague (text external) information given by the student during the recall, the lower the comprehension score. These hypotheses were formulated because it was believed that erroneous and vague information was given when a reader's background knowledge did not allow him to interpret the text either correctly or adequately.

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[a] Note: The coefficients (correlations) on the curved, double-headed arrows are shown in Table 8. The parameter estimates (standardized betas and the residual) are presented in Table 10. Key to the variable mnemonics: TSPEC = text specific information; TENT = text entailed information; TERR = text erroneous information; TEXT = text external information; RDGCOMP = reading comprehension; e_1 = the residual.

Since the principal factor for the Content domain was not used in the analysis, hypotheses 2A, 2B, 2C and 2D did not have to be reworded; rather they were tested as originally stated. Each hypothesis is dealt with in turn.

Hypothesis 2A: The greater the amount of text specific information given, the lower the reading comprehension score, when taking into account the effects of the other Content domain variables.

The results of the regression analysis presented in Table 10 indicated that the standardized beta coefficient between reading comprehension and verbatim or text specific information was .049 which was not significant. Hypothesis 2A was, therefore, rejected. This meant that in the presence of the other three Content variables (text entailed, text erroneous and text external) the amount of information memorized and reproduced had no effect on the child's ability to comprehend.

Hypothesis 2B: The greater the amount of text entailed information given, the higher the reading comprehension score, when taking into account the effects of all the remaining

TABLE 10

Content and Reading Estimates: Structural Coefficients, R-Square, and F-ratio[a]

Independent Variables	Dependent Variable: RDGCOMP				
	Simple Correlation	Regression Coefficients	Standardized Reg. Coeffs.	F-ratio	p
TSPEC	.271	.094	.049	.117	ns
TENT	.390	.708	.437	10.052	.005
TERR	-.226	-1.361	-.372	13.323	.001
TEXT	.143	.242	.050	.211	ns
Constant	42.51				
R-square	.275				
Residual	.851				

[a] The underlined simple correlation coefficient is not significantly different from zero at the .05 level of significance. Key to the variable mnemonics: TSPEC = text specific information; TENT = text entailed information; TERR = text erroneous information; TEXT = text external information; RDGCOMP = reading comprehension.

Content domain variables.

The standardized beta coefficient between integrated or reconstructed information and reading comprehension was .437 and was significant at the .005 level. Hypothesis 2B was, therefore, accepted. This meant that in the presence of the other Content variables, the amount of information a child was able to infer, summarize or reconstruct as he read had a strong and positive effect on his ability to comprehend during reading.

Hypothesis 2C: The greater the amount of text erroneous information given, the lower the reading comprehension score, when taking into account the effects of the other Content domain variables.

The standardized beta coefficient between the amount of erroneous information given and reading comprehension was -.372 which was significant at the .001 level. Hypothesis 2C was, therefore, accepted and interpreted to mean that in the presence of the other Content variables, the amount of information erroneously interpreted while reading had a definite negative effect on ability to comprehend.

Hypothesis 2D: The greater the amount of text external information given, the lower the reading comprehension score, when taking into account the effects of the other Content domain variables.

The standardized beta coefficient between vague information and reading comprehension was .050 and was not significant. Hypothesis 2D was, therefore, rejected. This meant that when the students in this sample gave vague information or when they used story telling conventions it had no effect upon their ability to comprehend when taking into account the other three influences in the model.

The most surprising finding from this analysis was the .049 coefficient between reading comprehension and text specific information, especially given the correlation coefficient between text specific and text entailed information (.714) and between text specific and reading comprehension (.271) both of which were significant. The amount of verbatim recall information did not seem to matter very much when text entailed information, erroneous information and external information were simultaneously taken into account.

The same situation seemed to be true for text external information; the amount of information that was vague and unclear did not seem to matter relative to verbatim, integrated and erroneous information. However, this was not particularly surprising because, although text external information did correlate significantly with text specific (.458), with text entailed (.387) and with text erroneous (.266), it had a very low and non-significant correlation with reading comprehension (.143). One could interpret this to mean that the positive correlations between text external and the other Content variables occurred simply because the more information given in a recall the more likely the reader was to give vague generalizations and to use story telling conventions and that these were, like mazes, simply stalling tactics to allow "think time" as the reader recalled the story and, hence, were not directly related to comprehension.

The correlation between text specific and reading comprehension was twice as high (and significant) as it was between text external and reading comprehension. Therefore, the former relationship was definitely important. What may have been happening, given the high correlation between text specific and text entailed information (.714) and the moderate correlation between text specific and text erroneous information (.303) was that the significance of verbatim information was subsumed in the production of integrated and erroneous information. This probably occurred because of the high degree of overlap or multicollinearity between the independent variables in the model; especially between text specific information and text entailed information. Since the abstraction of specific or detailed information from the text was necessary for the production of both text entailed information and text erroneous information as well as for text specific information, it is easy to understand why the variables overlapped; they all had a common base.

The importance, then, was not in the abstracted information itself but in what the reader did with the information as he read; that is, did he integrate, synthesize and summarize the incoming pieces of information or did he lack the relevant background and convert it into erroneous ideas? If he simply recalled the abstracted information verbatim, it was not a predictor of reading comprehension in the presence of entailed and erroneous information.

At this point in the analysis it was necessary to decide whether or not to use text specific and text external in further analysis since they had little effect on comprehension scores over-and-above the other two predictors. Due to the nature of the text external information and because it had a very low non-significant correlation with reading comprehension, it was decided to eliminate this variable from further analysis. It was not, in fact, giving any insight into the kind of information extracted and utilized during reading.

The ability to abstract text specific type of information, however, was felt to be a prerequisite to giving both text entailed and text erroneous information and did correlate significantly with reading comprehension. Therefore, this variable was kept for further analysis, especially since it was of key theoretical interest to the study.

The Structure Sub-Model

The Structure of a student's recall was measured through the use of staging variables, logical connective variables and referential connective variables. The theory suggested that the better the child was able to organize and interrelate pieces of incoming information the better the child would be able to comprehend. The original hypotheses stated that: (1) the more closely the staging in a recall resembled the original text, the higher would be a reader's comprehension score; and (2) the greater the number of logical and referential connectives used the higher the comprehension score.

As a result of the factor analyses described in Chapter IV, the staging variables were eliminated and composites were constructed for the connective variables after eliminating some connectives and collapsing the remaining seven logical connectives with the remaining eight referential connectives. Based upon the factor analysis, hypotheses 3A, 3B and 3C had to be rewritten as follows.

Hypothesis 3A: The greater the use of Descriptive connectives the higher the comprehension score, when taking into account the effects of the Associative and Integrative connectives.

Hypothesis 3B: The greater the use of Associative connectives the higher the comprehension score, when taking into account the effects of the Descriptive and Integrative connectives.

Hypothesis 3C: The greater the use of Integrative connectives the higher the comprehension score, when taking into account the effects of the Descriptive and Associative connectives.

The results of the regression analysis for this segment of the study are presented in Table 11 and a diagrammatic representation of the model is presented in Figure 8. The standardized regression coefficient between Descriptive connectives and reading comprehension was .036 which was not significant; between Associative connectives and reading comprehension was .220, significant at the .05 level; and between Integrative connectives and reading comprehension was .351 which was significant at the .001 level. Hypothesis 3A was, therefore, rejected while hypotheses 3B and 3C were accepted. This meant that, relative to the effect of the use of Associative and Integrative connectives, the use of Descriptive connectives had no effect on reading comprehension scores. It also meant that the use of Integrative connectives had a more powerful effect on reading comprehension than did the use of Associative connectives.

In substantive terms this meant that it was not important how well the readers were able to concatinate or string together bits of information as they were reading; rather what was important for comprehension was how well they were able to associate one incoming idea with another incoming idea and, even more important, how well they were able to integrate more than two ideas into a meaningful whole. Given the finding from the Content domain of discourse processing, this was not surprising since there, too, it was not important to be able to simply recall verbatim pieces of information; rather, what

TABLE 11

Connectives and Reading Estimates: Structural Coefficients, R-Square and F-ratios[a]

	Dependent Variable: RDGCOMP				
Independent Variables	Simple Correlation	Regression Coefficients	Standardized Reg. Coeffs.	F-ratio	p
DESCR	.030	.331	.036	.124	ns
ASSOC	.178	2.113	.220	4.531	.05
INTEG	.325	3.209	.351	11.497	.001
Constant	45.498				
R-Square	.155				
Residual	.919				

a. The underlined simple correlation coefficient is not significantly different from zero at the .05 level of significance. Key to the variable mnemonics: DESCR = Descriptive dimension of the connectives factor; ASSOC = Association dimension of the connectives factor; INTEG = Integration dimension of the connectives factor; RDGCOMP = reading comprehension.

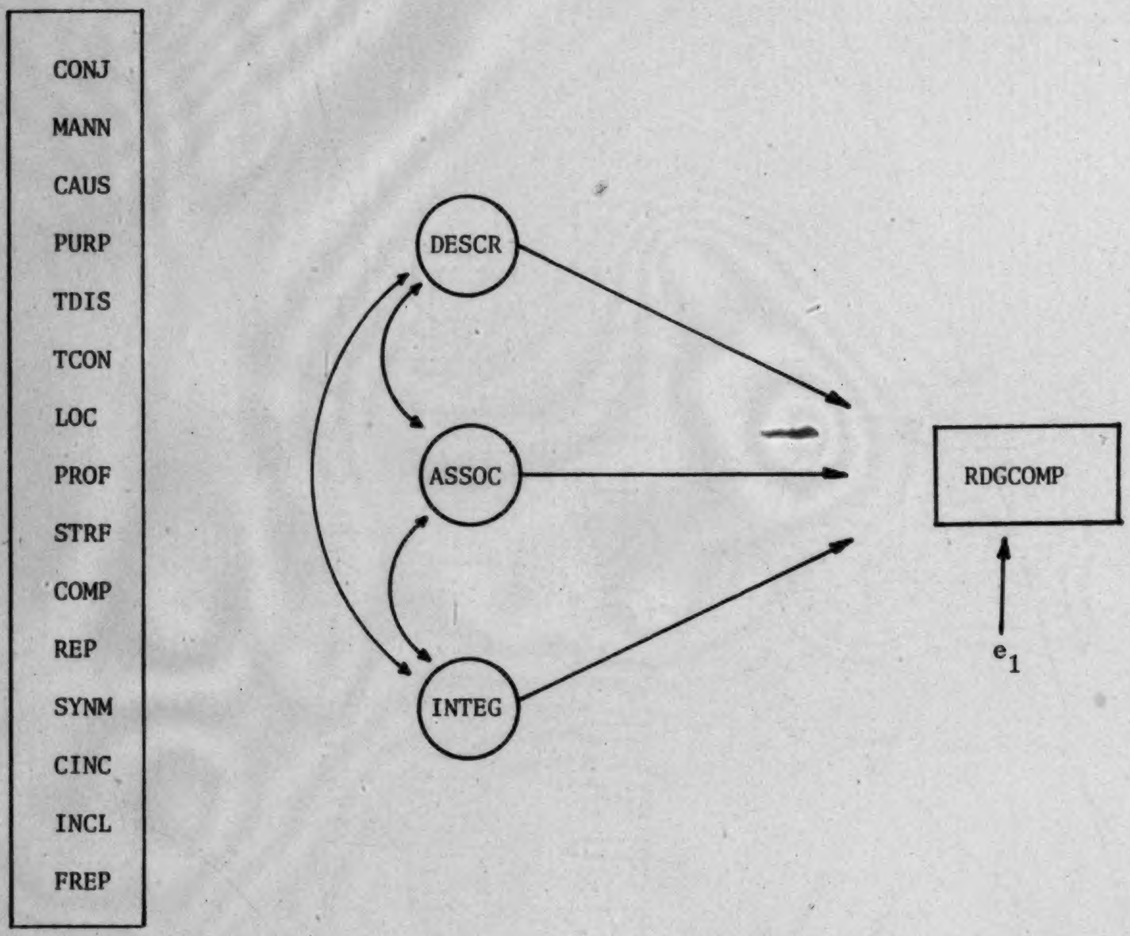

FIGURE 8. Specified Relationships in the Structure Sub-Model[a]

was important was how well the child could integrate, synthesize or summarize the incoming pieces of information.

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[a] Note: The parameters of the outer relationships (factor score coefficients) are presented in Table 7. The parameters of the inner relationships (standardized betas and the residual) are presented in Table 11. Correlations between the latent variables are shown in Table 8. Residuals on the structure variables = $\sqrt{1 - h^2}$. Observed variables are enclosed in rectangles while the latent variables are circled.

When considering the correlation matrix in Table 8, the results of the regression analysis were not surprising. Description had a -.027 correlation with Association, a -.002 correlation with Integration and a .030 correlation with reading comprehension, all of which were non-significant. This indicated that Description was unassociated with either Association, Integration or reading comprehension. Association, on the other hand, had a -.117 non-significant relationship with Integration but a .178 significant association with reading comprehension. This meant that when Association was considered relative to Description and Integration, it assumed slightly more importance for reading comprehension than when just the relationship of Association with reading comprehension was considered alone. Integration had the highest correlation coefficient with reading comprehension (.325) and consequently would have the greatest effect in the regression analysis. It is useful to note that because the three independent variables were composite constructions based upon the factor score coefficients from an orthogonal rotation factor analysis, the three variables were statistically independent of each other for this analysis as well as for analyses conducted later in the study.

Integration of the Content Sub-Model with the Structure Sub-Model

Because of the decision to eliminate text external information from further analyses, it became necessary to re-factor the three remaining Content variables (text specific, text entailed, text erroneous) in order to establish a new Content composite. The results of this second factor analysis for the Content domain are shown in Table 12. Note that each of the three remaining variables increased its weighting (as compared to Table 5) when one of the variables was dropped. However, the ranking of the three factor scores did not change. These new factor scores were then used to construct a Content 2 composite.

The two sub-models of discourse processing were then combined by including the factor composites from Content 2 and from the Structure variables in a regression analysis with reading comprehension as the dependent variable. The premise behind this technique was that the Content 2 composite would indicate the quality of the kind of information the student was processing and the Structure composites would indicate how well the student was relating together the incoming information. Since the Integrative composite in the Structure Sub-Model had been the most important predictor of comprehension ability, it was assumed that in this model it would still have the strongest effect of the three Structure composites. It was also thought that the Content 2 composite would serve as an additional predictor of comprehension scores over-and-above the Structure variables, since it was thought to be measuring a different kind of information. Thus, hypothesis four read as follows.

Hypothesis 4: The Content 2 variables will have a significant and positive effect on reading comprehension over-and-above the effects of the Structure domain variables.

A diagrammatic representation of the integration of the Content Sub-Model and the Structure Sub-Model is presented in Figure 9. The results of the regression analysis are presented in Table 13. As indicated, the Integrative composite from the Structure variables had

TABLE 12

Content Variable No. 2: Principal Component Analysis[a]

Items	Principal Component	h^2	Factor Score Coefficients
TSPEC	.894	.799	.471
TENT	.881	.777	.465
TERR	.566	.321	.299

a. Key to the variable mnemonics: TSPEC = text specific information; TENT = text entailed information; TERR = text external information.

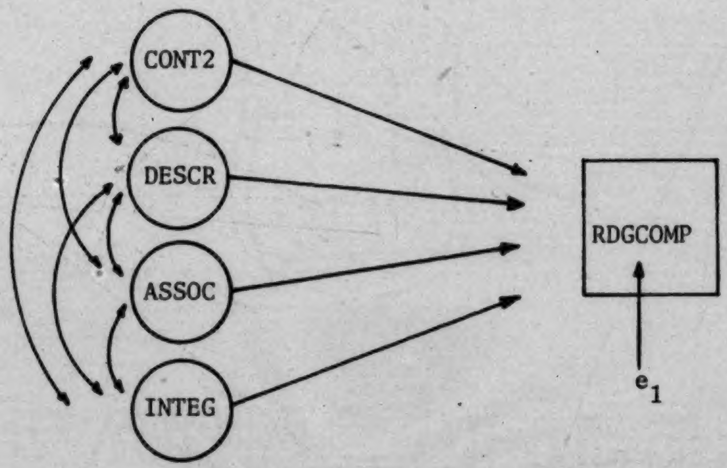

FIGURE 9. Integration of the Content Sub-Model and the Structure Sub-Model[a]

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[a] Parameter estimates (standardized betas and the residual term) are shown in Table 13. Correlations between source variables are shown in Table 8.

TABLE 13

Integrated Discourse Processing Model Estimates:

Structural Coefficients, R-Square, and F-ratios[a]

	Dependent Variable: RDGCOMP				
Independent Variables	Simple Correlation	Regression Coefficients	Standardized Reg. Coeffs.	F-ratio	p
CONT2	.238	-3.715	-.408	1.054	ns
DESCR	.030	3.012	.329	1.177	ns
ASSOC	.178	4.183	.436	3.464	.10
INTEG	.325	4.931	.539	6.554	.025
Constant	45.471				
R-Square	.166				
Residual	.913				

a. The underlined simple correlation coefficient is not significantly different from zero at the .05 level of significance. Key to the variable mnemonics: CONT2 = information Content; DESCR = Descriptive dimension of the connectives factor; ASSOC = association dimension of the connectives factor; INTEG = Integration dimension of the connectives factor; RDGCOMP = reading comprehension.

the greatest effect on reading comprehension with a significant standardized beta coefficient of .539. The Associative composite had the next highest coefficient (.436) which was only significant at the .10 level. The Descriptive composite was not significant which was not surprising given the previous analysis. The substantial negative coefficient (-.408) of the Content 2 composite was also not significant. Hence, hypothesis 4 was rejected.

Note that the correlation coefficient between Content 2 and reading comprehension was .238 and significant. Yet when Content 2 was entered into the regression analysis along with the Structure composites, the standardized beta coefficient was -.408 but was not significant. Note also that the correlation coefficient between the Description composite and reading comprehension was .030 which was non-significant but the beta coefficient was .329 although still not significant. Such dramatic shifts without significance being reached usually indicates that a high degree of multicollinearity exists between the predictor variables.

Multicollinearity, as pointed out earlier, refers to the presence of highly intercorrelated independent variables in structural models and is particularly problematic when using ordinary least squares regression techniques to estimate the model. Among the problems that occur are: (1) large standard errors so that the estimates of the model parameters become unstable and insignificant; and (2) some estimates are reduced while others may be excessively large and even of the incorrect sign (Blalock, 1963).

As a result of the instability of the beta coefficients, the correlation matrix in Table 8 was examined to determine where the greatest amount of overlap was occuring. It was found that the Content 2 composite and the Description composite were highly correlated (.704) which meant that they were measuring much the same thing. The Content 2 correlation with Association was .457 and with Integration was .399. This, in effect, meant that there was considerable overlap between what the Structure composites and Content 2 were measuring.

Because there seemed to be considerable commonality between Content 2 and the Structure composites, it was decided to construct a principal component single factor composite for all fifteen Structure variables. Once that was accomplished a correlation between the two single factors could be calculated to determine the degree of overlap between all of the variables in the Content domain and all of the variables in the Structure domain. The results of the factor analysis for a single factor composite on Structure variables are given in Table 14. A Connect composite was then constructed using the factor score coefficients.

The correlation coefficient between the two factors, Content 2 and Connect, is shown in Table 8 and was .966. Undoubtedly then, what had happened was that the researcher had, in fact, used two different ways of measuring the same thing rather than measuring two distinct strategies, the what and the how, that were believed to be involved in the processing of discourse. This seemed to indicate that the instruments used to measure discourse processing variables were not fine enough to measure two theoretically distinct strategies.

It may also have meant that these strategies were distinct theoretically but in practice were so closely associated that one could only measure something more global called "content and structure". It

TABLE 14

Connectives Variables: Principal Component Solution with Factor Score Coefficients[a]

Items	Factor Loadings I	h^2	Factor Score Coefficients
CONJ	.832	.692	.169
MANN	.733	.537	.096
CAUS	.605	.366	.074
PURP	.711	.505	.083
TDIS	.683	.467	.087
TCON	.606	.368	.068
LOC	.749	.561	.097
PROF	.784	.614	.118
STRF	.543	.295	.079
COMP	.560	.313	.059
REP	.833	.693	.167
SYNM	.601	.361	.051
CINC	.649	.422	.060
INCL	.609	.371	.058
FREP	.527	.278	.062

a. Key to the variable mnemonics: CONJ = logical conjunction connective; MANN = logical manner connective; CAUS = logical causality connective; PURP = logical purpose connective; TDIS = logical temporal disjunction connective; TCON = logical temporal conjunction connective; LOC = logical location connective; PROF = referential proform pronoun connective; STRF = referential story pronoun connective; COMP = referential complementizer connective; REP = referential repetition connective; SYNM = referential synonym connective; CINC = referential class inclusion connective; INCL = referential inclusion connective; FREP = referential formal repetition connective.

will be recalled that this is what happened when graphics and phonics were measured separately and when syntax and semantics were measured separately. Whatever the case, it appeared that Content 2 and Structure could not be integrated into one comprehensive model. In effect this meant that, from there on in, the study could use either Content 2 or Structure as a measure of the way in which readers were abstracting and integrating information as they read, but the two could not be used simultaneously.

Two questions still remained. First, was the single composite for Content 2 a viable means of measuring the content of the information that a reader processed when reading? Second, given that Content 2 and Structure were different ways of measuring the same underlying constructs, which set of variables was the most appropriate to use? These problems are dealt with in Chapter VI.

Integration of the Cueing Strategy Model and the Discourse Processing Strategy Model

The final aspect of this chapter deals with the findings related to hypotheses 5A, 5B, 5C and 5D. The concern of these hypotheses was with: (1) how much a reader's proficiency in graphics and phonics and in syntactics and semantics affected the Content of their recall; and (2) how much it affected the Structure of the recall. Given the two dimensions found in the cueing strategies and the three dimensions found in the Structure variables during the factor analyses, it became necessary to reword the hypotheses slightly.

Hypothesis 5A: The greater the dependence on the Grapho-Phonic strategy the lower the performance in the Content domain when taking into account the effects of the Syntactic-Semantic strategy.

Hypothesis 5B: The greater the dependence of the Grapho-Phonic strategy the lower the performance on each of the three dimensions of the Structure domain,when taking into account the effects of the Syntactic-Semantic strategy.

Hypothesis 5C: The greater the proficiency in the Syntactic-Semantic strategy the higher the performance in the Content domain, when taking into account the effects of the Grapho-Phonic strategy.

Hypothesis 5D: The greater the proficiency in the Syntactic-Semantic strategy the higher the performance on each of the three dimensions of the Structure domain, when taking into account the effects of the Grapho-Phonic strategy.

The procedure for testing these hypotheses was through the use of four regression analyses. First Content 2 was regressed on the Grapho-Phonic and Syntactic-Semantic composites. Second, the Description composite was regressed on the two cueing strategy composites; third, the Association composite was regressed; and finally, Integration was regressed. The results of these analyses are presented in Table 15.

Hypothesis 5A was rejected on the grounds that a non-significant and very low (almost nonexistent) standardized beta coefficient occurred between Grapho-Phonics and Content 2. This meant that the dependency on Grapho-Phonics did not affect (either positively or negatively) the reader's recall content. When one considers the correlation coefficients between Grapho-Phonics and the recall variables in Content 2 (see Table 8) it becomes evident that there were no significant relationships and hence, the ability to use Grapho-Phonics was unrelated to the kind of information the reader

TABLE 15

Estimates of the Cueing Strategy and Discourse Processing Strategy Relationships: Structural Coefficients, R-Square, and F-ratios[a]

	Dependent					Variables				
	CONT2					DESCR				
Indep. Vars.	Simple Corr.	Regressn Coeff.	St. Reg. Coeff.	F ratio	p	Simple Corr.	Regressn Coeff.	St. Reg. Coeff.	F ratio	p
GP	.034	.051	.049	.237	ns	-.071	-.066	-.064	.377	ns
SS	.246	.268	.249	5.925	.025	.104	.107	.100	.907	ns
Constant	-.000					-.002				
R-Square	.063					.015				
Residual	.968					.992				

TABLE 15 (cont'd.)

Indep. Vars.	Dependent					Variables				
	ASSOC					INTEG				
	Simple Corr.	Regressn Coeff.	St. Reg. Coeff.	F ratio	p	Simple Corr.	Regressn Coeff.	St. Reg. Coeff.	F ratio	p
GP	.090	.095	.097	.869	ns	.060	.078	.076	.562	ns
SS	.110	.119	.117	1.245	ns	.252	.276	.257	6.358	.025
Constant	.016					-.001				
R-Square	.022					.069				
Residual	.989					.965				

a. The underlined simple correlation coefficients are not significantly different from zero at the .05 level of significance. Key to the variable mnemonics: GP = Graphophonic cueing strategy; SS = Syntactic-Semantic cueing strategy; CONT = information Content; DESCR = Descriptive dimension of the connectives factor; ASSOC = Association dimension of the connectives factor; INTEG - Integration dimension of the connectives factor.

gave in the recall situation.

Hypothesis 5B was also rejected because, again, very low and non-significant standardized betas occurred between Grapho-Phonics and all three Structure composites; -.064 for Description, .097 for Association and .076 for Integration. This meant that the use of Grapho-Phonics had no effect on the type of connective used nor consequently on how well the reader structured his recall through the use of the connectives.

Hypothesis 5C was accepted since the standardized beta coefficient between SS (Syntactic-Semantic) and Content 2 was .249 and significant. While it is difficult to assess whether or not a significant coefficient constitutes a high quality of recall content, especially given the nature of the Content 2 composite, one can examine the correlation coefficients between SS and the variables comprising the Content 2 construct. Table 8 indicated that SS correlated with text specific information at the .256 level, with text entailed at the .325 level, and with text erroneous at the -.087 level. Text entailed information appeared to be of a more complex nature than text specific because it involved not just verbatim or exact recall of textual information but rather an inferring, synthesizing and summarizing of textual information. Since the highest correlation was with text entailed information and since the correlation with text erroneous information was negative, very low and non-significant, it could safely be argued that a positive and significant beta coefficient did indeed imply that the greater the proficiency in the use of the Syntactic-Semantic cueing strategy the higher the quality of the Content of the recall.

This finding was, of course, as one would expect. Those students who were proficient at using their background knowledge of language and of the world had an adequate knowledge framework to which they could relate incoming information, and with which they could integrate many incoming pieces of information. This also prevented them from misinterpreting textual information and, hence, the non-significant relationship with text erroneous information.

Hypothesis 5D was partially accepted because of the standardized beta coefficient of SS with Integration (.257 and significant). It was pointed out in Chapter IV that the Integration composite consisted of connectives that were of a more complex nature than the connectives constituting the Description and the Association composites. The use of Integrative connectives necessitated that the reader be able to interrelate more than two pieces of incoming information whereas the use of Description connectives did not necessitate the interrelation of any information. To use Association connectives, a reader had only to relate one piece of information to another. It could be argued, then, that an effective structuring of a recall would involve the use of Integrative connectives; the greater the use of such connectives the more effective the structuring.

The standardized beta between SS and Description was .100, which was not significant and between SS and Association was .117, again not significant. What these findings indicated, then, was that those readers who were effective users of the Syntactic-Semantic cueing strategy were also those readers who were able to integrate several pieces of incoming information as they were reading. This was hardly surprising given the similar findings in the relationship between SS and text entailed information mentioned above. It is also interesting at this point to remember that, earlier in the chapter, it was found in the Content Sub-Model that the standardized beta between reading comprehension and text entailed information was .437, the highest for all Content variables and reading. Further, it was found in the Structure Sub-Model that the standardized beta coefficient between reading comprehension and the Integrated composite was .351, again the highest of all three Structure composites. This observation will be dealt with in more detail in Chapter VI when the cueing strategy model is integrated with the discourse processing model to evaluate the effects of each model on reading comprehension.

CHAPTER VI

FINDINGS II: ESTIMATION AND DISCUSSION OF AN INTEGRATED MODEL OF READING COMPREHENSION

Chapter VI is a logical extension of Chapter V in that it integrates the two basic models discussed in the previous chapter. The purpose of integrating the models is to test the major hypothesis of the study; that the discourse processing strategies will have positive and independent effects on reading comprehension over-and-above the effects of the cueing strategies. If this hypothesis is accepted on statistical grounds, it means that the two theories discussed in Chapters I and II are both contributing toward explaining how readers comprehend and are, therefore, complementary rather than competing. To be competing, one or the other would have to dominate and only one theory would have a significant effect on comprehension ability.

Hypothesis 6B, which is related to the main hypothesis 6A, is also tested in this chapter. Hypothesis 6B stated that some of the effects of the cueing strategies on reading comprehension would be mediated by the discourse processing strategies. This means that if hypothesis 6B is accepted the cueing strategies will have both a direct and an indirect effect on comprehension ability; that is, cueing strategies will affect reading comprehension ability and cueing strategies will also affect discourse processing strategies which, in turn, will affect reading comprehension ability.

The chapter begins with the presentation of a correlation matrix for all variables discussed (see Table 16). Most variables in

TABLE 16

Correlation Matrix, Means, and Standard Deviations of the Integrated Model of Reading Comprehension[a]

Vars.	GP	SS	TSPEC	TENT	TERR	CONT2	DESCR	ASSOC	INTEG	CONCAT	SYNTH	ASSOCIAT	RDGCOMP
GP	1.000	94	94	93	93	93	93	93	93	93	93	93	84
SS	-.065	1.000	94	93	93	93	93	93	93	93	93	93	84
TSPEC	-.059	.256	1.000	93	94	94	94	94	94	94	94	94	84
TENT	.049	.325	.714	1.000	94	94	94	94	94	94	94	94	84
TERR	.127	-.087	.303	.269	1.000	94	94	94	94	94	94	94	84
CONT2	.034	.246	.894	.881	.567	1.000	94	94	94	94	94	94	84
DESCR	-.071	.104	.645	.572	.451	.704	1.000	94	94	94	94	94	84
ASSOC	.090	.110	.327	.425	.353	.457	-.027	1.000	94	94	94	94	84
INTEG	.060	.252	.424	.477	-.076	.399	-.002	-.117	1.000	94	94	94	84
CONCAT	-.032	.013	.571	.447	.690	.683	.941	.052	-.151	1.000	94	94	84
SYNTH	.008	.350	.669	.729	-.144	.611	.209	.078	.899	.000	1.000	94	84
ASSOCIAT	.119	.070	.223	.348	.411	.390	-.127	.983	-.141	-.001	-.001	1.000	84
RDGCOMP	-.136	.596	.271	.391	-.226	.239	.030	.178	.325	-.110	.457	.119	1.000
Means	.000	.000	4.54	8.70	2.92	-.000	-.002	.016	-.001	-.002	.000	.001	45.53
SDs	.979	.929	4.76	5.63	2.49	1.00	.998	.952	.999	1.00	1.00	1.00	9.13

a. Correlation coefficients below the diagonal; number of cases used in construction of correlation coefficients above the diagonal. The underlined correlation coefficients are not significantly different from zero at the .05 level. Key to the variable mnemonics: GP = Grapho-phonic strategy; SS = Syntactic-Semantic strategy; TSPEC = text specific information; TENT = text entailed information; TERR = text erroneous information; CONT2 = recall Content; DESCR = Descriptive connectives; ASSOC = Associative connective; INTEG = Integrative connective; CONCAT = Concatenative information; SYNTH = Synthesized information; ASSOCIAT = Associated information; RDGCOMP = reading comprehension.

the table are unmeasured composite variables and, therefore, do not have interpretable means. There are only four exceptions; reading comprehension, text specific information, text entailed information and text erroneous information. As in Chapter V, standardized partial beta coefficients were estimated using ordinary least squares regression analysis and were used to test hypotheses 6A and 6B.

The cueing strategy and discourse processing models were integrated in three ways, with procedures two and three dependent upon the decisions made as a result of the findings from the immediately preceding integrated model.

Integrated Model #1

Although it was pointed out in Chapter V that there were problems with collinearity when the Content composite was included with the Descriptive, Associative, and Integrative composites as discourse processing strategies, it was decided to include these overlapping dimensions in the first integrated model in order to confirm that the findings reported earlier held up when the Grapho-Phonic and the Syntactic-Semantic variables were also part of the model. Table 17 presents the results of Integrated Model #1. By looking at the standardized coefficients between the dependent variable, reading comprehension, and the six independent variables, one can see that even in the presence of Grapho-Phonics and Syntactics-Semantics, the Content composite assumed an unstable coefficient (-.358 which was not significant). Again it seemed that collinearity between the discourse processing composites was probably causing the instability. Consequently, a modification to the model had to be made.

TABLE 17

A Fully-Specified Integrated Model: Structural Coefficients, R-Square, and F-ratios[a]

	Dependent					Variables				
	CONT2					DESCR				
Indep Vars.	Simple Corr.	Regressn. Coeff.	St. Reg. Coeff.	F ratio	p	Simple Corr.	Regressn. Coeff.	St. Reg. Coeff.	F ratio	p
GP	.034	.051	.049	.237	ns	-.071	-.066	-.064	.377	ns
SS	.246	.268	.249	5.925	.025	.104	.107	.100	.907	ns
CONT2										
DESCR										
ASSOC										
INTEG										
Constant	-.000					-.002				
R-Square	.063					.015				
Residual	.968					.992				

TABLE 17 (cont'd.)

Indep. Vars.	Dependent					Variable				
	ASSOC					INTEG				
	Simple Corr.	Regressn. Coeff.	St. Reg. Coeff.	F ratio	p	Simple Corr.	Regressn. Coeff.	St. Reg. Coeff.	F ratio	p
GP	.090	.095	.097	.869	ns	.060	.078	.076	.562	ns
SS	.110	.119	.117	1.245	ns	.252	.276	.257	6.358	.025
CONT2										
DESCR										
ASSOC										
INTEG										
Constant	.016					-.001				
R-Square	.022					.069				
Residual	.989					.965				

TABLE 17 (cont'd.)

Indep. Vars.	Dependent Variable				
	RDGCOMP				
	Simple Corr.	Regressn. Coeff.	St. Reg. Coeff.	F ratio	p
GP	-.136	-1.201	-.129	2.95	ns
SS	.596	5.066	.516	32.429	.000
CONT2	.239	-3.266	-.358	1.167	ns
DESCR	.030	2.096	.229	.814	ns
ASSOC	.178	3.337	.348	3.144	ns
INTEG	.325	3.578	.387	4.733	.05

Constant 45.480

R-Square .434

Residual .752

a. See Table 16 for key to the mnemonics.

Reconstructing Discourse Processing Composites

In recursive models such as the present one, the commonest method of coping with collinearity is through model simplification. This may be achieved in two ways. First, because multicollinearity indicates that some independent variables convey little information over those of other variables, one way of scaling down a model is to drop variables. In this instance, it would seem logical to drop either Content or the three Structure variables and then re-estimate the model.

A second method is to aggregate the variables through the use of confirmatory factor analysis. This latter solution was attempted first. Since the Content aspect of the discourse processing consisted of only one composite which was not particularly meaningful, it was decided to factor the components of the Content 2 composite (text specific, text entailed, text erroneous) with the three Structure composites (Description, Association and Integration). The results of this factor analysis are presented in Table 18. If satisfactory results had not been obtained from a VARIMAX solution, a procrustean solution could have been attempted.

Three factors were extracted because three factors had emerged in the Structure variables. As well, there were only three variables remaining in the Content composite that were meaningful. The coefficients in the factor matrix of Table 18 clearly indicated that there were three factors. Factor I was a Concatination factor representing a stringing together of text information that was interpreted either correctly or incorrectly. The key variables included in this factor as indicated by the large factor loadings

TABLE 18

Discourse Processing Factors: Factor Matrix from Orthogonal Rotation (VARIMAX) and Factor Score Coefficients[a]

	Factor Matrix				Factor Score Coefficients		
Items	I	II	III	h^2	I	II	III
TSPEC	.571	.669	.224	.823	.187	.287	.036
TENT	.447	.729	.349	.853	.068	.344	.164
TERR	.690	-.143	.411	.666	.393	-.249	.203
DESCR	.941	.209	-.126	.945	.598	-.059	-.314
ASSOC	.052	.078	.984	.976	-.191	-.006	.807
INTEG	-.151	.900	-.140	.850	-.254	.594	-.125

a. Key to the variable mnemonics: TSPEC = text specific information; TENT = text entailed information; TERR = text erroneous information; DESCR = Descriptive dimension of the connectives factor; ASSOC = Association dimension of the connectives factor; INTEG = Integration dimension of the connectives factor.

were text erroneous information and Descriptive connectives. It seemed that the readers abstracted ideas that they could string together through the use of Descriptive connectives. When they erroneously interpreted the abstracted information, it was still included in the string of information presented in the recall but not always in an accurate manner.

It is difficult to say why the readers, on many occasions during the recall, were concatinating information rather than interweaving the ideas into a complex network. One possibility is that their perception of understanding and/or retelling a story was simply to string the information together. In other words, their background knowledge of story schema may have been one that conceived of a story as a series of pieces of information. Another possibility is that they did not understand the relationship of particular pieces of information to the overall story schema but included it by adding it on as they remembered it. The erroneous information may have also been given because of the reader's background knowledge. It is possible that the reader may have used either erroneous background knowledge or the wrong background knowledge to interpret some of the information. Or he may simply have lacked the background knowledge to interpret the information and, therefore, said whatever he thought might conceivably fit in with the story.

Factor II was some kind of Synthesizing factor consisting of TSPEC, TENT, and INTEG. Statistically this factor was the most easily interpreted because the factor loadings were high on the three variables constituting the factor (TSPEC = .669; TENT = .729; and INTEG = .900) and very low on the variables not included in the factor. Substantively, this factor was also easily interpretable. Readers abstracted and recalled specific information from the text. They also synthesized, summarized, or integrated other pieces of abstracted information. Finally, they related both specific and integrated information to their background knowledge to assist them in making the inferences necessary for comprehending the text.

Factor III was a singleton and was simply the Association factor of the Structure composites. To reiterate, it consisted of the ability of readers to relate two pieces of information together. It was an ability that was more complex than simply stringing ideas together but less complex than interweaving several ideas together.

Once the three factors had been extracted the factor score coefficients in Table 18 were used to construct three new latent variable composites that were then used in the Integrated Model #2 for the discourse processing strategies.

Integrated Model #2

Due to the previously mentioned collinearity between the discourse processing composites, it was undesirable to test hypotheses 6A and 6B using Integrated Model #1. The revised model, then, included a Grapho-Phonic composite and a Syntactic-Semantic composite as the cueing strategy variables. The discourse processing variables included Concatinized, Synthesized, and Associated information composites and the dependent variable remained the same. The relationships in the revised integrated model are depicted in Figure 10.

The results of the regression analyses used to test the hypotheses are presented in Table 19. As can be seen, when reading comprehension

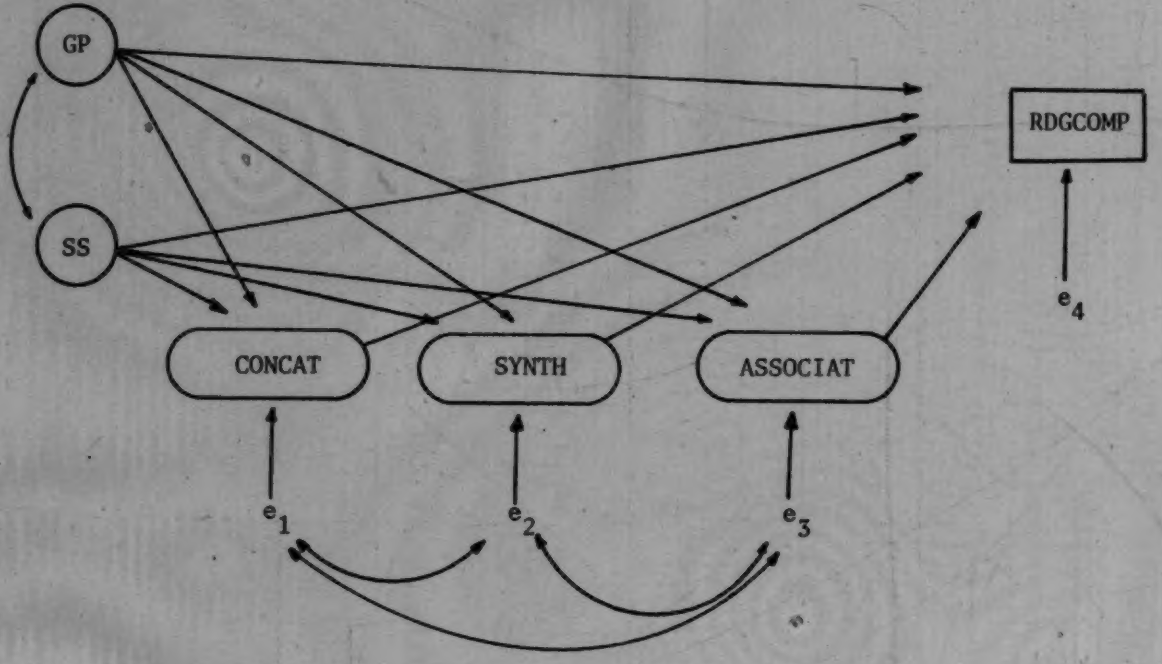

FIGURE 10. Integrated Model #2[a]

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[a] Note: The model parameters (standardized betas and the residuals) are presented in Table 19. The correlations between the residuals of the discourse processing variables are as follows: $R_{CONCAT,SYNTH.GP,SS} = -.002$; $R_{SYNTH,ASSOCIAT.GP,SS} = -.033$; $R_{CONCAT,ASSOCIAT.GP,SS} = .007$.

TABLE 19

Integrated Reading Comprehension Model: Structural Coefficients, R-Square, and F-ratios[a]

	Dependent					Variables				
	CONCAT					SYNTH				
Indep. Vars.	Simple Corr.	Regressn. Coeff.	St. Reg. Coeff.	F ratio	p	Simple Corr.	Regressn. Coeff.	St. Reg. Coeff.	F ratio	p
GP	-.032	-.032	-.031	.088	ns	.008	-.031	.030	.096	ns
SS	.013	-.012	.011	.011	ns	.350	.379	.352	12.654	.01
CONCAT										
SYNTH										
ASSOCIAT										
Constant		-.002					-.0003			
R-Square		.001					.123			
Residual		.999					.936			

TABLE 19 (cont'd.)

Indep. Vars.	Dependent					Variables				
	ASSOCIAT					RDGCOMP				
	Simple Corr.	Regressn. Coeff.	St. Reg. Coeff.	F ratio	p	Simple Corr.	Regressn. Coeff.	St. Reg. Coeff.	F ratio	p
GP	.119	.127	.124	1.414	ns	-.136	-1.148	-.123	2.145	ns
SS	.070	.084	.078	.557	ns	.596	4.722	.481	28.976	.001
CONCAT						-.110	-1.101	-.121	2.100	ns
SYNTH						.457	2.651	.290	10.682	.005
ASSOCIAT						.119	.913	.100	1.422	ns
Constant		.0007					45.525			
R-Square		.020					.461			
Residual		.999					.734			

a. The underlined simple correlation coefficients are not significantly different from zero at the .05 level of significance. Key to the variable mnemonics: GP = Graphophonic cueing strategy; SS = Syntactic-Semantic cueing strategy; CONCAT = Concatenative information; SYNTH = Synthesized information; ASSOCIAT = Associated information; RDGCOMP = reading comprehension.

was regressed on all five composite variables, SS and SYNTH were the only two that were significant. The standardized beta coefficient between reading comprehension and the use of the Syntactic-Semantic cueing strategy was .481, clearly the most important predictor of comprehension ability. The standardized beta between reading comprehension and the ability to synthesize, integrate and infer information during reading (SYNTH) was .290. These two significant coefficients indicated that SS and SYNTH were each affecting the reader's ability to comprehend while taking into account the influence of the other independent variables in the model. Hypothesis 6A was, therefore, partially accepted. It could not be fully accepted because neither all of the cueing strategy variables nor all of the discourse processing variables had significant effects; rather only one variable from each set of strategies was important over-and-above the others.

In substantive terms this meant that only part of the cueing strategy theory and part of the discourse processing theory were contributing toward the reading comprehension of the grade four students. Clearly, the ability to use syntactics and semantics was the most important factor in this model for influencing the ability to comprehend during reading. The only other factor in the model contributing toward comprehension ability was the ability to use Synthesis strategies; that is, the ability to abstract enough pertinent information from the text so that it could be summarized, synthesized, and integrated with background knowledge so that the necessary inferences could be made in order to fully understand the text at hand. Because these two aspects of the theories were complementary the theories are compatible and can be integrated into a comprehensive model of reading comprehension.

The fact that three factors in the model did not contribute significantly toward comprehension ability is somewhat problematic. To infer from the non-significant relationships that Grapho-Phonics is not important in reading comprehension and, therefore, need not be considered of importance in teaching children to read is, of course, absurd. What it does indicate, however, is that, given the grade and reading level of the sample, grapho-phonics was assuming a less and less important role in reading ability while syntactics and semantics was assuming a more and more important role. By grade four, most readers and especially the more proficient readers have internalized grapho-phonic relationships to the extent that they have become automatic, and the use of syntactics and semantics has become of paramount importance in comprehending print written at an ever increasingly complex level. Those students who are still reading at a level where grapho-phonic abilities have not become automated and, hence, whose reading demands considerable attention to grapho-phonics at the expense of attention being directed toward syntactics and semantics, will not be capable of comprehending at the same complex level as the more proficient reader. Hence, for this sample there was a negative, although non-significant, relationship between reading comprehension and Grapho-Phonics. What is being suggested here is that, at this grade level, the emphasis in reading may be shifting. During the first three years of school a great deal of time is spent in teaching the child to crack the code of print. Beginning reading stories are often so familiar to young children, or if not the story itself the theme is familiar, that the reader often need only decode the print and the story becomes meaningful. As the child progresses in school and becomes more at ease in deciphering print, the stories become more complex and, as a result, the child has to interrelate more and more pieces of information, infer more often what is not clearly stated, and relate whatever part of the story he is familiar with to his background knowledge in order to make some kind of sense out of the whole thing. If the reader is still mostly concerned with the grapho-phonics of the situation, little attention can be paid to the increasingly complex tasks demanded of him if he is expected to comprehend at a higher and higher level.

The fact that CONCAT and ASSOCIAT had low, non-significant relationships with RDGCOMP in the presence of SS and SYNTH also implied that, like GP, these abilities at the grade four level were assuming less and less importance as the ability to synthesize and integrate information on a more complex scale became more and more important. Again, it could be argued that the ability to concatinate, or string together pieces of information as well as the ability to relate two pieces of information together served as a basis for the more complex integration of several pieces of information. The proficient reader, then, was the one who had automated or become adept at stringing and associating bits of information but had then moved on to the next step of complexity, that of interrelating all of the pieces of information. As was the case with Grapho-Phonics, it may have also been that when readers were still consumed with stringing together and/or making one-to-one relationships between the bits of incoming information, that little attention could be paid to integrating all of the pieces of information into a meaningful whole.

In models such as the present integrated model, it is possible to figure out what the direct effect and indirect effect of the first set of variables are (see Figure 10). In this instance the first set of variables to be considered were the Grapho-Phonic and Syntactic-Semantic variables. These were observed temporally prior to the observation of the discourse processing variables (see Chapter II). For this reason they can be regarded as source (or first) variables while the discourse variables can be considered as intervening variables since they intervene or mediate the effects of the source variables on the outcome, reading comprehension.

To establish the direct effects of GP and SS on RDGCOMP, one simply looks at the standardized beta coefficients between each variable and the outcome variable. To establish the indirect effects, significant standardized betas between the source variables and the intervening variables are multiplied by the significant standardized coefficients between the intervening variables and the outcome variable (Finney 1972). The direct and indirect effects are then added together to give the total effects of each source variable.

Since SS was the only source variable with significant relationships to the intervening and outcome variables, it was the only variable for which total effects were established. The indirect effect of SS on RDGCOMP was mediated by SYNTH, the only significant discourse variable, and was .352 x .290 = .102. The direct effect of SS on RDGCOMP was .481. Thus, the total effect of SS on RDGCOMP was .102 + .418 = .538. Hence, hypothesis 6B was only partially accepted on the grounds that only one discourse processing variable mediated the effect of one cueing strategy variable.

In substantive terms this meant that the ability to utilize the Syntactic-Semantic cueing strategy had a fairly strong effect on the reader's ability to comprehend. However, SS ability also affected the ability to use Synthesis strategies, which in turn affected comprehension ability. This indirect use of SS, plus the direct use, had a very strong effect on the ability of the students in this sample to comprehend. The use of the Syntactic-Semantic cueing strategy by these grade four readers was the most important factor influencing their comprehending ability.

Integrated Model #3

The alternate method of scaling down a model with overlapping variables is to drop some of the problematic variables. In this instance the Content and the Structure composites overlapped. Since the two significant predictors TENT and TERR from the Content Sub-Model (Chapter V, Table 10) had stronger effects than the two significant predictors ASSOC and INTEG from the Structure Sub-Model (Chapter 5, Table 11), it was decided to eliminate the Structure variables and to use the significant Content predictors as processing strategy variables in a simplified integrated model of reading comprehension. The source variables remained Grapho-Phonics and Syntactic-Semantics, and the intervening variables became text entailed information and text erroneous information. The simplified model is represented in Figure 11.

The results of the regression analysis for this model are presented in Table 20 and are basically the same as those results for the fully integrated model; that is, for Integrated Model #2. A conceptual diagram is presented in Figure 11. SS still had the highest coefficient with RDGCOMP (.465) when taking into account all other variables in the model. Text entailed had the next highest coefficient (.314) which was not much different from the coefficient between the composite variable SYNTH (Table 20) and RDGCOMP (.290) of which TENT was the contributing variable. The effect of the text entailed variable, then, was independent of the effect of the Syntactic-Semantic composite.

The effect of text erroneous information on reading comprehension in this model was negative and significant (a beta coefficient of -.259) as one would expect. It seemed that when text erroneous information was considered by itself, rather than part of the composite CONCAT (Table 19) it had a significant effect over-and-above the effects of GP, SS and TENT. These results meant that two discourse processing strategy variables had effects over-and-above the effects of the cueing strategy variables. Again, it seemed that the two theories exhibited the properties of complementarity; and, therefore, constituted complementary explanations. As a result they can be legitimately integrated into a more comprehensive model of reading.

In this simplified model only indirect effects for SS via TENT on RDGCOMP (.330 x .314 = .104) were calculated.

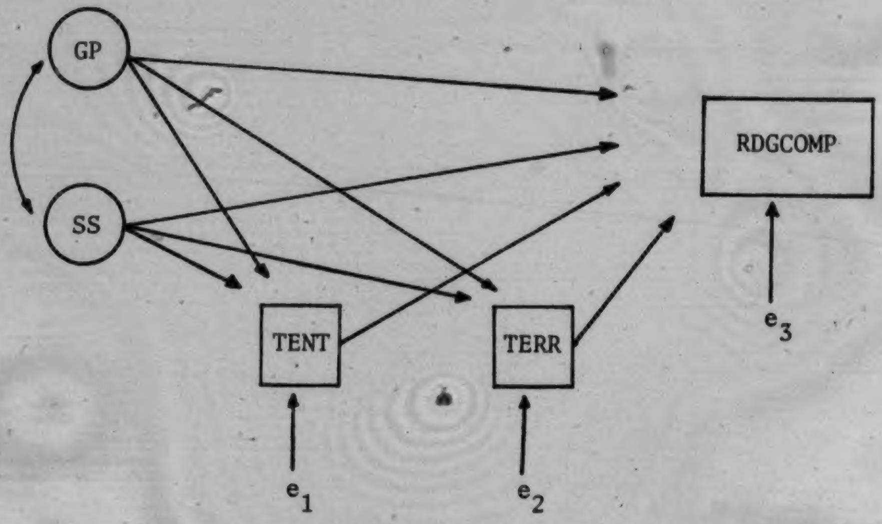

FIGURE 11. A Simplified Model of Reading Comprehension[a]

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[a] The model parameters are shown in Table 20.

TABLE 20

An Alternative and Simplified Integrated Reading Comprehension Model: Structural Coefficients, R-Square, and F-ratios[a]

	Dependent Variables									
	TENT					TERR				
Indep. Vars.	Simple Corr.	Regressn. Coeff.	St. Reg. Coeff.	F ratio	p	Simple Corr.	Regressn. Coeff.	St. Reg. Coeff.	F ratio	p
GP	.049	.407	.071	.506	ns	.127	.311	.122	1.366	ns
SS	.325	1.999	.330	10.962	.005	-.087	-.211	-.079	.567	ns
TENT										
TERR										
Constant		8.701					2.926			
R-Square		.111					.022			
Residual		.924					.989			

TABLE 20 (cont'd)

Indpendent Variables	Dependent Variables				
	RDGCOMP				
	Simple Corr.	Regressn. Coeff.	St. Reg. Coeff.	F ratio	p
GP	-.136	-.826	-.089	1.146	ns
SS	.596	4.573	.465	27.735	.001
TENT	.391	.509	.314	11.829	.005
TERR	-.226	-.948	-.259	8.856	.005
Constant		43.873			
R-Square		.471			
Residual		.727			

a. The underlined simple correlation coefficients are not significantly different from zero at the .05 level of significance. Key to the variable mnemonics: GP = Grahphophonic cueing strategy; SS = Syntactic-Semantic cueing strategy; TENT = text entailed information; TERR = text erroneous information.

This meant that the total effect for the Syntactic-Semantic cueing strategy on reading comprehension was .465 + .104 = .569 which was very close to the total effect in the fully integrated model (.583). It would seem, then, that the simplified model was just as effective in estimating the parameters of an integrated model as the more complex integrated model. In future research, then, it would seem that the most parsimonious procedure would be to use just the Content variables for measuring the discourse processing strategies.

CHAPTER VII

SUMMARY AND CONCLUSIONS

The final chapter is divided into four sections: (1) the theoretical implications; (2) the practical implications; (3) the implications for further research; and (4) a concluding statement. The first section of the chapter is, perhaps, the most important given the two major purposes of the study as stated in Chapter I: (1) to clarify the theory underlying recall analysis; and (2) to integrate the two theories of reading comprehension. The study, then, has been predominantly concerned with theory clarification and confirmation. There are, of course, practical implications for both teaching and research but this has not been the main thrust of the study at this point in time.

Theoretical Implications of the Findings

This section is divided into three sub-sections: (1) confirmation of the cueing strategy theory; (2) clarification of discourse processing theory; and (3) the confirmation of a comprehensive integrated theory of reading comprehension. Each will be dealt with in turn.

Confirmation of the Cueing Strategy Theory

The ideas presented in Chapter II indicated that readers not only use the graphics and the phonics, or the letter-sound relationships, as they read; rather they also use their knowledge of language (syntax) and their knowledge of the world (semantics) as they interact with print in a "hypothesis testing" situation. Such an interaction between the incoming linguistic information, as represented by the graphics and associated phonics, and the reader's world knowledge, as represented by the syntactic and semantic cues in the print interacting with the reader's experiences, is referred to by Royer and Cunningham (1978) as the "minimal principle" of reading.

The weak aspect of the principle can be likened to the Grapho-Phonic cueing strategy abstracted in this study from the four elements comprising the cue selection theory. Here the reader predominantly utilizes the perceptual processes of reading which include identifying features in letters, letter-sound relationships, spelling patterns, words and word meanings. For the most part, then, the Grapho-Phonic strategy is used to relate visual perceptions to word meanings. The strong form of the "minimal principle" maintains that the use of such letter and word identification strategies merely "sets the stage" for comprehending. As units larger than words become the basis for integrating the linguistic input with prior knowledge, the Syntactic-Semantic cueing strategy becomes predominant and provides the "click of comprehension" so familiar to readers as they grasp an author's intended meaning and, thereby, move from the use of the weak to the strong form of the minimal principle.

This study found that, in fact, the use of the Grapho-Phonic cueing strategy did not contribute significantly to a reader's ability to comprehend. This could be interpreted, in the light of the minimal principle, to mean that the use of the Grapho-Phonic strategy simply prepared the child for comprehending in that it allowed him to identify the words in print that were then utilized in clusters or chunks to relate to his language and world knowledge. It seemed, then, that what was important in comprehending was the ability of the reader to go beyond the use of the Grapho-Phonic strategy and to use the Syntactic-Semantic strategy as much as possible in order to achieve a high degree of comprehension. The better the reader was at utilizing his language knowledge in conjunction with his knowledge of the world in order to interpret incoming pieces of linguistic information, the higher was his comprehension score. It is as though, by the beginning of grade four, the use of the Grapho-Phonic strategy had become a given for most pupils in the sample. What did vary considerably was the reader's ability to step beyond such a restricted understanding of reading and to use, as well, the Syntactic-Semantic strategy as a means of elaborating on textual information, drawing conclusions, evaluating and checking the validity of their initial interpretations of the print.

Clark and Haviland (1977) talked of the "contract" situation in reading whereby a reader expects to find both known information within the print as well as unknown information. What the reader then must attempt to do is to seek out the old or known information contained in the message and fit in or somehow accommodate the new or unknown information. The efficient use of prior knowledge, both linguistic and experiential, becomes critical in this "given-new contract" situation. As was shown by the importance in this study of the Syntactic-Semantic strategy, when the given information was not within the reader's cognitive framework, it became impossible for the reader to generalize from past experience to the new situation and, of course, difficult to assimilate new information because of non-existent old information. It is possible and highly likely that many readers in this sample did, in fact, have both the linguistic ability and the world knowledge that was necessary to be an efficient comprehender. However, they may not have known how to use such information and instead tended to rely almost solely on the Grapho-Phonic strategy, simply saying the words or saying something as close as possible grapho-phonically to the text word. While their miscues often lacked grammatical acceptability and meaning, the miscues usually sounded quite similar to the expected response. This situation did not enhance comprehension; rather it had a slight negative effect, although the effect was not significant.

The theory put forth by the proponents of cueing strategies, namely the Goodmans, has been well substantiated in this study. Perhaps most important is the fact that, for this sample at least, the efficient use of the Syntactic-Semantic strategy far outweighed the efficient use of the Grapho-Phonic strategy as a predictor of comprehending ability. This, of course, has been a basic postulate of cueing strategy theorists and the results of the present study add credence to their claim.

Clarification of the Discourse Processing Strategy Theory

As was pointed out in Chapter I, the advocates of recall analysis have not based their analytic procedure on a strong cohesive theory. Rather, they have worked from the assumption that readers abstract information from print, relate it to their own experiences and then construct an interpretation of the text. Exactly how readers perform these operations has been vague and inadequately specified. Through the use of two statistical procedures, factor analysis and regression analysis, some insight has been gained in this study as to how the readers in this sample were utilizing abstracted information in order to construct meaning. Unfortunately, the procedures of the study did not permit the observation of how the reader intuitively decided on which information to abstract.

An attempt was made to observe what kind of information the readers were extracting and how they were relating the abstracted pieces of information together. Due to the instruments used to measure discourse processing variables, it was not possible to separate the "what" from the "how" of the child's abstracting and constructing procedures. In effect what happened was that the instrument thought to be measuring what was abstracted was also measuring how the abstracted bits were related together. Similarly, the instrument thought to be measuring the interrelationships of the abstracted information was at the same time taking into consideration what kind of information had been abstracted. Hence, the two instruments both measured the same thing. Further refinement of the existing instruments or the use of alternate instruments may overcome this problem. For the present study, however, it was sufficient that some progress was made toward empirically validating what it was that the readers in this sample were doing as they abstracted and constructed meaning during reading.

Four findings of major importance for discourse processing theory were obtained. The first arose from the regression analysis of reading comprehension with the recall information categories; the second arose from the factor analysis of the connective variables; the third from the regression of reading comprehension on the connective Structure composite variables; and the fourth from the second order factor analysis whereby the Content variables were collapsed with the Structure composites to form comprehensive discourse processing variables.

The first important finding arose when it was discovered that the effect of abstraction of verbatim information had no effect upon reading comprehension when taking into consideration the degree to which the reader summarized, synthesized or otherwise integrated other abstracted information with his background. Such integrated information did have considerable effect upon comprehending ability as did information that was misconstrued, presumably as a result of the lack of cognitive structures or schemata to which abstracted information could be related or because of the erroneous abstraction of information from the text. Such erroneous information was probably also attributable to the fact that because subjects were encouraged to give as long a recall as they could, they often seemed to be incorrectly "making up" what they had not understood or giving additional misinformation about an event simply to give a longer recall.

The important finding, then, from this segment of the analysis was that the verbatim recall of literal information in the story was not an important factor in comprehending ability. What was important was the reader's ability to use such information to generate a more complex kind of information containing new propositional knowledge which resulted from the interaction of the selected information and the reader's store of knowledge. The results of this study then clearly supported the claim put forward by Fredericksen (1977) that two levels of processing occur during the reading of connected discourse. First, propositional units of information are selected from the text at an interpretive level. Then the units are combined with frames, concepts or events of already existing knowledge at an inferential level. This in effect says that in order to do the latter one must be able to do the former. A correlation coefficient of .714 between the verbatim information and the integrated information in this study, together with the regression analysis already referred to, seemed to substantiate these claims. In effect, the use of specific information became somewhat of an underlying and necessary ability for comprehending. Where the variability occurred was in how readers were able to utilize such information by combining it with what they already knew in order to understand the text beyond a superficial recall of detail level.

The second important finding disclosed the fact that there were three basic types of connectives that the readers in this sample used to piece together the bits of information which they had abstracted from text. First, children used words to concatinate or string together what often appeared to be random bits of information. Rather than being a procedure for organizing information in some interrelated and over-all meaningful way, it was predominantly a joining together of facts from the story. The second type of connective used was one that indicated a definite relationship between two pieces of information. Here there seemed to be an attempt to integrate and to show the relationship of one event to a second event. The third set of connective words used in organizing information during reading was referred to as Integrating connectives. These connectives were used to perceive and convey the interrelationship of many ideas and events. This meant that readers using these connectives were interweaving the incoming bits of information in a complex and highly structured manner.

The importance of this finding for the discourse strategy theory is that there were three distinct strategies that readers were using to try to piece together the meaning of the text. Up until this point, the only claim that had been made was that readers related the incoming information to their background knowledge through the use of their linguistic knowledge and were, therefore, able to interrelate the pieces of abstracted information. Now it seems that the methods they use to do this are at least somewhat delineated. Which of these procedures was most important for enabling the reader to comprehend text was disclosed by the third important finding for the discourse processing variables.

When the three composite variables discussed above were used in a regression equation with reading comprehension, it was found that the ability to string together pieces of information had no effect upon the ability to comprehend when considered in addition to the ability to associate and integrate information. The ability to relate one piece of information to another piece of information had some effect but the ability to integrate several pieces of information had the most powerful effect of all three. This meant that if a reader was not able to organize the incoming information in such a way that events and ideas were related to one another, comprehension ability was not as proficient as it would have otherwise been; that is, the more the informational units were clustered, whether through Association or Integration, the better the comprehending ability.

What this probably meant for the grade four readers in the sample was that the ability to string together ideas was not a sufficient ability to ensure comprehension at an ever increasingly complex level. While it is more or less true that stories for beginning readers are sequenced in a very simplistic and chronological way and, hence, the ability to string ideas together one after another may well enhance comprehension ability, this was not the case for the story used in this study. In order to follow the sequence of events in the story "Space Pet", the reader had to be able to note interrelationships of time and space since the text consisted of a series of flashbacks, projections into the future, and present occurrences in a continually mixed order. This meant that these grade four readers had to have developed an ability beyond the concatenating level so frequently stressed in beginning reading instruction. Perhaps, then, this descriptive element in organizing incoming text is, like the grapho-phonic ability, more or less a given for readers at this level and what really matters is their ability to associate two ideas together and, even more important, the ability to perceive the relationships between many events and concepts. This finding coincides with the first finding discussed under this section and so it should since the two measurements pertaining to the two findings were, in fact, measuring the same thing.

The fourth finding of considerable importance for discourse processing occurred as a result of integrating or collapsing the variables from the Content and the Structure measurements. It was found that the text erroneous and the Descriptive variables constituted a dimension which was labeled Concatination and referred to the students' stringing together of either accurate or inaccurate information. The text specific, text entailed and Integration variables formed a second construct and represented the reader's ability to use abstracted information as the basis for establishing complex relationships suggested within the story. The third construct was a single variable, the ability to associate two pieces of information as a means of organizing information.

These findings were important because they indicated that considerable erroneous and Descriptive information was given when children were overly-dependent on simply stringing ideas together at the expense of using their conceptual frameworks to assist them in organizing and integrating incoming information. Further, they indicated that the use of verbatim and synthesized, summarized and inferred information was closely associated with the use of Integrating connectives. These three types of information worked together to form what might be thought of as a global synthesizing of information ability. Finally, the ability to associate two pieces of information seemed to fall somewhere in between the use of the other two strategies. Perhaps it is a step in the progression from heavy reliance on the concatinating of ideas to relating together two pieces of information as a result of background experiences, to finally being able to interrelate many pieces of information by incorporating and synthesizing them into one's existing schematic framework.

The importance of this fourth finding stemming from the results of the second order factor analysis lies in the fact that it acted as a confirmation of the clustering of variables that made up the three strategies used to organize continuous discourse. It seems that the basic assumptions underlying the use of recall analysis could be formulated into a broad theoretical framework which, with measurement refinements, could most likely be specified more precisely. What has been found from the present study is that children in grade four, first of all abstracted during reading what they considered to be the necessary information from the text. They then performed three operations on such information. First, they strung some of the information together. Second, the readers began to interrelate the abstracted information by making the association between two pieces of information. This may have been a step toward the desired goal of interrelating many pieces of information. Hence, it did have some effect on the ability to comprehend beyond the mere interpretation of literal facts. Third, the readers reached the final step, at times, and indicated in their recalls that they were able to interrelate many pieces of information. It is necessary to point out that many readers used all three strategies. As was shown in Table 19, the use of the first strategy had a slight negative effect on comprehending ability which was not significant, while the use of the second strategy had a slight positive effect but was also not significant. The key to successful comprehension at this level was the use of the third strategy, the integration of information strategy.

Confirmation of a Complementary Integrated Theory of Reading Comprehension

As was pointed out earlier, one of the major purposes of the study was to assess whether the similarities and differences underlying the cueing strategy theory and the discourse processing theory would permit the integration of the two theories in a complementary manner. The findings in Chapter VI indicated that at least some of the components of each theory were important predictors of comprehension when the theories were combined.

When the two theories were tested in the Integrated Model #2 (Table 19), the Syntactic-Semantic variable and the Synthesizing variable were both significantly related to reading comprehension. The Syntactic-Semantic cueing strategy was the most powerful predictor of comprehension but the Synthesizing ability in organizing information still had an effect over-and-above the effect of Syntactic-Semantic skill. This basically meant that, although the readers used background knowledge and linguistic ability to predict meaning and then to confirm the predictions, they were also using background knowledge in the form of interrelated schemata which allowed them to organize incoming information by relating together and slotting the new information into an already existing framework.

While it is true that both of these uses of background knowledge must have been related, they were not the same thing. This was evidenced by a correlation coefficient of .350 (Table 17) between the Syntactic-Semantic variable and the Synthesizing variable as well as by the fact that the Synthesizing variable still had a predictive value over-and-above the predictive value of the Syntactic-Semantic variable.

To expand this claim it could be said that both strategies utilized anticipation during reading. Anticipation when using the Syntactic-Semantic strategy occurred predominantly at a word, phrase, sentence, or paragraph level and probably from one paragraph to the next paragraph. This seemed to be a crucial strategy for comprehension given the beta coefficient of .481. However, in addition to such anticipation, was the anticipation at a broader or more general level; that is, at a schema level. Given that the reader had a schema for what constituted a story and what constituted episodes within a story, he was able to use these schema to interrelate incoming information. Hence, schemata had an effect (.290) on comprehending by acting as organizers over-and-above the effect of Syntactic-Semantics which were used at a less global level.

In Chapter VI the indirect effect of the Syntactic-Semantic variable on reading comprehension via the Synthesizing variable was also discussed and found to be .102. The direct effect as noted above was .481. Hence, the total effect of the Syntactic-Semantic cueing strategy on reading comprehension was .583. This was, indeed, a powerful total effect coefficient and indicated that when the Syntactic-Semantic strategy was used effectively it affected the use of the Synthesizing strategy which in turn affected reading comprehension. The use of the Syntactic-Semantic strategy in this manner, then, enhanced its effect so that it became an even more powerful predictor of reading comprehension.

On the basis of the relationships stated above, it was claimed that the two theories could be integrated. It was also claimed that the theories were complementary rather than competing because at least some aspects of each theory contributed to an understanding of comprehension ability when the components of the theories were considered simultaneously. Because of the clear cut evidence for the importance of the Syntactic-Semantic and Synthesizing strategies for reading comprehension in the Integrated Model #2, it was decided to conduct a factor analysis of all six variables in the model -- RDGCOMP, CONCAT, SYNTH, ASSOCIAT, SS and GP. The idea was that those variables which clustered with reading comprehension would be the variables representing the strategies that were a part of comprehending ability. The clustering of the remaining variables would indicate how the other strategies were related to one another but not directly related to reading comprehension. Table 21 presents the results of the analysis.

TABLE 21

Confirmation of Variable Clustering: Factor Matrix from Orthogonal Rotation (VARIMAX)[a]

Items	Factor Matrix			
	I	II	III	h^2
RDGCOMP	.880	-.038	.012	.776
CONCAT	-.141	-.105	.947	.928
SYNTH	.694	.060	-.039	.486
ASSOCIAT	.152	.727	.283	.631
SS	.802	-.029	.111	.657
GP	-.140	.786	-.127	.654

a. Key to the variable mnemonics: RDGCOMP = reading comprehension; CONCAT = Concatenating strategy; SYNTH = Synthesizing strategy; ASSOCIAT = Association strategy; SS = Syntactic-Semantic strategy; GP = Graphophonic strategy.

As can be seen from the factor matrix coefficients, three factors emerged. The first was clearly a comprehension factor and included reading comprehension, the Synthesizing strategy and the Syntactic-Semantic strategy. The abilities underlying these three variables had much in common and were basically concerned with the same thing. The second factor was one that appeared to involve the ability to associate two things. The variables that loaded on this factor were those representing the Associating strategy and the Grapho-Phonic strategy. As was mentioned previously, the Association variable represented the ability to associate two pieces of incoming information. The Grapho-Phonic variable also represented the ability to make the association between two things, this time between the graphics or the letters and the phonics or the sounds the letters represent. Hence, there was a strong relationship between these two abilities but neither of them seemed to have a lot to do with comprehension. They may, however, be forerunners to comprehension and in that sense have been crucially important to comprehension while not directly related to it.

The final factor consisted of a single variable, the Concatination variable and represented the simplistic use of information abstracted from the text. Students who were often just stringing ideas together may not have been using their cognitive structures to assist them in interweaving the ideas. The readers also gave erroneous information perhaps because they did not have adequate cognitive structures to which they could relate the abstracted information, or they were using the wrong background knowledge in interpreting the print. In either case, this strategy had little to do with comprehending ability. It seemed that what was important for reading comprehension was the ability to use one's language facility and one's background knowledge in order to predict or anticipate, to confirm the prediction or anticipation and to integrate information on a word, phrase, sentence, and paragraph level as well as across whole sections of text. The other strategies may have been important forerunners to comprehension but they were not part of comprehension.

Practical Implications of the Findings

In a recent publication by the International Reading Association which is edited by Santa and Hayes (1981) and entitled *Children's Prose Comprehension: Research and Practice*, reference is made in the introductory chapter to an account written by David Pearson on the resurgence of interest in comprehension. His claim is that comprehension at this point in time has become a dominant concern of both psychologists and educators. During the seventies there was a marked shift in psychological studies away from the behavioristic tradition where stimulus/response observables were of consuming interest to mentalistic and unobservable cognitive processes. Since reading comprehension is both mentalistic and unobservable directly, it has become a prime concern in the field of cognitive psychology.

Reading educators have, during the sixties, reached a fairly clear consensus on the issues of teaching word identification. In oversimplifying the issue, what seems to have happened is that an eclecticism has emerged among teachers, researchers, and clinicians as to how best to teach word identification skills. As a result of such agreement energy, time and interest have shifted to issues on what is, and how best to teach reading comprehension.

This shift coincides with the growing uneasiness among teachers and administrators that something problematic is occurring in reading along about the grade four level. Pearson claims that several administrators have complained to him that test scores begin declining at the fourth year level. Teachers are concerned that while they do a creditable job of teaching word identification skills, their ability to teach comprehension skills is far from adequate. Consequently, teachers are requesting workshops to assist them in understanding how children comprehend, why they fail to comprehend, and what to do with and for them when they fail. The understanding of comprehending ability, then, has become a key concern not only for teachers of reading but for researchers as well.

The importance of the present research for this resurgence of interest in comprehension is twofold. First, it confirms teachers' hunches that decoding skills at the grade four level are, generally, fairly well developed and that the emphasis clearly needs to be elsewhere. The results of the basic cueing strategy model indicate that teachers would be well advised to place their emphasis on assisting readers in learning how to use what they already know about language and the world to assist them in understanding print. If the reader's background is not adequate for the particular task at hand, then time needs to be spent developing sufficient schemata to enable the reader to cope with what he is expected to read. In other words, a shift in emphasis in developing strategies is clearly suggested from this research; a shift away from the development of Grapho-Phonic skills and toward the development of Syntactic-Semantic skills.

Second, the present research clearly indicated that the most proficient readers were those who could abstract information from print and then interrelate the information at a fairly complex level. Of the three strategies (stringing ideas together, associating two ideas, and interrelating many ideas) the one that seems to need to be developed carefully is the integrative strategy. This, of course, is a most difficult teaching task, much more difficult than assisting children in picking out details from a story and recalling them in a run-on fashion. However, to date it seems that much of the emphasis in teaching reading comprehension has been just that. Attention has also been paid to trying to get children to concatinate ideas into a story sequence and to see how one piece of the story fits in with the next, thereby, making some associations. The area of interrelating many ideas from within passages has either been dealt with haphazardly or on a very limited basis.

Perhaps the emphasis at the grade four level needs to shift so that students begin relating ideas together through learning to paraphrase and to use connectives that encourage the perception of interrelationships within the text. Teachers acting as models can show children how ideas are woven together by giving a summary or synopsis of a story. Ideas from the story read could be jotted down, then a succinct paraphrase using suggested integrative connectives could be undertaken by the teacher and students together and later by the students themselves. Suggestions along these lines are given in Pearson and Johnson (1978).

Stemming from these two suggestions is the follow-up suggestion that basal readers include more exercises that emphasize the Syntactic-

Semantic and the Integrating strategies. Rather than including so many worksheets on noting details or story sequence, a more profitable direction may well be in devising more exercises that necessitated making inferences, summarizing and synthesizing information or that asked the student to pick out five important ideas from a short passage. The reader could then write or verbalize these ideas into three sentences that show how the five ideas relate to one another. Again teacher modeling would be essential to begin with but before long many children may become proficient at such activities on their own.

Implications for Further Research

This section will focus on two suggestions for further research; namely, modifications in the research design and re-specification of the model.

Research Design

When the current study was conceived, explicit information on the nature of discourse processing was not available. Hence, the study had to be conducted at an exploratory level in order to identify the dimensions or features underlying the processing of continuous discourse. Since this study has been at least somewhat successful in that it identified three dimensions of such processing, future researchers may wish to build on these findings by using confirmatory factor designs or, alternately, by attempting to more carefully specify and measure each of the three constructs discussed in the study; namely, Descriptive ability, Associative ability and integrative ability.

Since the recall categories were as effective as the connective dimensions in predicting reading comprehension, and since each of the categories may be further disaggregated, a profitable procedure may be to modify the categories in order to more precisely measure a reader's abstractive and constructive processing ability. Further, it may be profitable to use smaller units of information (such as the syntactic structures devised by Fagan, 1978b) for analyzing recalls. In this way a comparison between the most appropriate sizes of units for recall analysis could be made.

In addition to confirming or altering the design through variable measurement, shorter passages may prove to reduce measurement error. A longer passage was deliberately selected for the current study but, as a result, it often seemed that many readers gave a very sketchy overview of the story during recall. It was believed by the researcher that in many instances the readers remembered far more than what they retold. It was as though these readers were purposely trying to make a long story short and, as a result, skipped or glossed over many important episodes that would have enhanced the interrelatedness of what they did retell. Possibly by using a series of shorter passages, the depth of recall for each passage would be more complete and enough information on each child's processing ability could be gleaned so that more valid discourse processing variables could be constructed.

Model Specification

A model can be respecified either through the addition of important variables that should have been included or through dropping variables that were erroneously included. In the present research, though some variables proved to be statistically insignificant, the sample size and the measurement error in the discourse processing component of the model may have accounted for this. Thus, if the sample size were increased and the measurement error reduced some of the apparently nonsignificant variables could turn out to be theoretically important. Therefore, there is little justification at this stage for dropping variables.

Several variables may have been omitted from the integrated model of reading comprehension. For example, reading comprehension is probably more than just a function of competency in the use of cueing strategies and discourse processing strategies. In addition, the child's level of hypothetico-deductive thinking may be a factor. There is also the possibility that instructional conditions within school classrooms may operate to either enhance or constrain reading comprehension. For example, the reinforcement/reward structure of the classroom may be a factor, as may be the opportunity to learn to read during class time. Research needs to be done in order to ascertain the extent to which the thinking stage of the child and the instructional conditions of the classroom affect reading comprehension.

Models may be extended both backwards and forwards. A researcher may wish to consider the backwards extension to the current integrated model through the inclusion of dimensions of the child's home environment. Good readers seem to have richer background experiences to draw on than poor readers. By an examination of the child's opportunities to enhance his general knowledge through family interaction and experiences, the predictive power of the model might be improved. Other dimensions of the home environment which may be of interest include the reinforcement structure and the expectation structure.

It is often forgotten that reading is the single most powerful predictor of competency in the content fields of schooling. In this sense, reading is an intervening variable. Thus, an obvious forward extension to the study would be to examine the model of reading as a predictor of performance in the major school subjects.

In future research, consideration should also be given to the formulation of dynamic models of reading comprehension; that is, through the specification of a longitudinal research design. In this way the researcher can incorporate variables which change over time into the design and can attempt to identify the change processes in reading.

It cannot be claimed on the basis of a single study that the integrated model of reading comprehension has been confirmed. Rather the research will have to be replicated, hopefully using improved instrumentation, a longitudinal research design, and improved model specification.

Concluding Statement

The goal of the present study was to formulate and estimate a model of the relationships between the reading strategies of grade four pupils and their reading comprehension. The views of researchers from two schools of reading research were drawn upon; the cueing strategy school which uses a psycholinguistic approach, and the discourse processing strategy school which uses an abstractive-constructive approach. Thirty-three independent variables were generated by the two theories which is far too many for model building purposes since the goal of model building is not to mirror the enormous complexity of reality but rather to reduce the features of that reality to a more manageable form.

The task, then, was to try to simplify each of the theories in order to evaluate the extent to which they were competing or complementary explanations of reading comprehension. First, inadequately measured variables or variables which conveyed little information over-and-above those of other variables were dropped. The remaining variables were clustered into groups, and those in each group were aggregated through the use of either confirmatory or exploratory factor analysis.

The result was the identification and measurement of two cueing strategy variables, the Grapho-Phonic strategy and the Syntactic-Semantic strategy, and four discourse processing strategy variables. The latter variables were referred to as a Content of recall strategy and three dimensions of the Structure of recall strategies; namely, Descriptive, Associative and Integrative.

Incremental model building begins with the formulation and estimation of simple or basic models. Work on more complicated systems proceeds by extension, elaboration and integration; that is, from what is known to what is unknown. Initially, four basic models were estimated using ordinary least squares regression: (1) a cueing strategy model; (2) a content sub-model; (3) a structure sub-model; and (4) an integration of the cueing strategy model with the two sub-models of discourse processing. The results showed that both theories separately constituted explanations of reading comprehension. The stage was set, then, for a test of an integrated model of reading comprehension. The estimates of the first integrated model were difficult to interpret. A second-order factor analysis of the combined Content and Structure variables was called for in order to further simplify the discourse processing strategies. These were finally identified as strategies related to Concatenation of information, the Association of information, and the Synthesis of information.

The estimates of the final integrated model of reading comprehension demonstrated convincingly that the two theories were complementary. This, in effect, means that it is minimally necessary to include both cueing strategies and discourse processing strategies in an explanation of reading comprehension.

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APPENDIX 1

CTBS Reading Comprehension Skills

READING COMPREHENSION

Skills Tested

D **(Details)** – To Recognize and Understand Stated or Implied Factual Details and Relationships
- **D-1** To recognize and understand important facts and details
- **D-2** To recognize and understand implied facts and relationships
- **D-3** To deduce the meaning of words or phrases from context

P **(Purpose)** – To Develop Skill in Discerning the Purpose or Main Idea of a Paragraph or Selection
- **P-1** To detect the main purpose of a paragraph or selection
- **P-2** To recognize the main idea or topic of a paragraph or selection

O **(Organization)** – To Develop Ability to Organize Ideas
- **O-1** To recognize common elements or parallel topics in incidents or paragraphs
- **O-2** To recognize proper time sequence

E **(Evaluation)** – To Develop Skill in Evaluating What is Read
- **E-1** To develop generalizations from a selection
- **E-2** To recognize the writer's viewpoint, attitude, or intention
- **E-3** To recognize the mood or tone of a selection
- **E-4** To recognize outstanding qualities of style or structure

APPENDIX 2

Reading Passage: "Space Pet"

Instructions to Students Before Reading the Passage

"I would like you to read this story out loud for me. While you are reading I'll have the tape recorder on. If you come to a word you don't know just say what you think it is and carry on. If you really can't get a word, skip it and keep on reading. After you have finished reading I'll ask you to tell me the story in your own words."

Instructions to Students After Reading the Passage

"Can you tell me the story in your own words? What was the story about? Tell me everything you can remember."

Space Pet

As far as I know there has never been a rule against pets in a space station. We had just never had any pets until Sven Olsen decided he wanted one. None of us ever figured out why he chose the pet he did.

I first saw Claribel when I was working in my office. I heard a musical whistle near my ear and thought it had come over the radio. I waited for the news to follow. Instead, there was a lovely song. I looked up and had my first view of Claribel.

She was a small yellow canary, hanging very still in the air. Her wings were folded quietly at her sides. She could stay that way because nothing has any weight in space. Before I recovered from the surprise of seeing a canary in our space station, she did a kind of backward loop. No earthbound canary could have done it.

In no time at all, Sven's pet was everybody's pet. We had a little trouble hiding her when important guests came to visit the space station. We couldn't be sure if we were breaking any rule having her there. But we liked her too much to take a chance on losing her.

Claribel always got noisy when we hid her. Sometimes we had to think fast to explain the peeps and whistles that came from the oddest places. There were a few narrow escapes, but then who would ever dream of looking for a canary in a space station?

All of us at the station were on duty for twelve hours at a time. This was not as hard as it sounds, since you need little sleep in space. Of course there is no "day" and "night" when you are always floating in sunlight. But we found it easier to think of time as being divided into day and night.

One "morning" when I woke up, I could scarcely drag myself out of bed. I was still only half awake when I joined the other men at breakfast. I noticed they seemed unusually sleepy, too. Then I saw that one seat at the table was empty.

"Where's Sven?" I asked.

"He's looking for Claribel," someone answered. "He can't find her. She usually wakes him up."

Just then Sven appeared at the door. In his hand lay a tiny bunch of yellow feathers, with claws sticking up in the air.

"What happened?" we asked.

"I don't know," said Sven sadly. "I just found her like this."

"Let's have a look at her," said Jock Duncan, our cook and doctor. We waited in silence while he held Claribel against his ear, trying to hear a heartbeat.

Presently he shook his head. "I can't hear her heart. But that does not prove she's dead. Let's try giving Claribel some oxygen."

Claribel was put into a face mask. It was as large as an oxygen tent for her. To our delighted surprise, she came back to life at once. Beaming broadly, Sven removed the mask and she hopped onto his finger. She sang her song, then fell over again in his hand.

"I don't understand what's wrong with her," said Sven. "She's never done this before."

For the last few minutes I had been trying to remember something. My mind seemed to be working very slowly, as if I were still sleepy.

Suddenly I understood. "There's something wrong with the air!" I yelled. "That's why Claribel passed out. I just remembered that coal miners often take canaries down into mines to warn the men when the air is bad."

"Oh no!" said Jim, our engineer. "The alarm would have gone off. We have two good warning systems."

"The second alarm isn't connected yet," another man reminded him. That really upset Jim. He left without a word. The rest of us passed around the oxygen bottle like an Indian peace pipe. We gave Claribel more oxygen, and she came back to life.

Ten minutes later Jim came back and explained what had happened. During the night, part of an air line had frozen and the alarm had failed to go off. Half a million dollars worth of engineering instruments had let us down. Without Claribel, all of us might have died.

Today, if you should visit a space station, don't be surprised if you hear a canary singing. It means you have a double safeguard at the cost of some birdseed.

APPENDIX 3

Code Sheet for Cueing Strategy Variables

Miscue Number	Reader	Text	GRAPHIC SIMILARITY 3			SOUND SIMILARITY 4			CORRECTION 6	GRAMMATICAL ACCEPTABILITY 7	SEMANTIC ACCEPTABILITY 8
			Y	P	N	Y	P	N			
1	fare	far	2			2			N	0	0
2.	Seve	Sven	2				1		N	2	2
3.	choose	chase	2			2			N	1	1
4.	a	the			0			0	N	2	1
5.	mustarical	musical	2			2			N	2	0
6.	fold	folded	2			2			N	2	1
7.	quiteley	quietly	2			2			N	2	0
8.	hid	did	2			2			Y	2	2
9.	blackward	backward	2			2			N	2	1
10.	Seve's	Sven's	2			2			N	2	2
11.	guesses	guests	2			2			N	2	0
12.	Come	came	2			2			N	1	1
13.	rules	rule	2			2			N	2	2
14.	like	liked	2			2			N	2	2
15.	space	station		1			1		Y	2	2
16.	here	her	2			2			N	1	1
17.	a	as	2			2			N	1	1
18.	—	are							N	0	0
19.	if	of	2				1		Y	2	2
20.	scarey	scarcely	2			2			N	2	0

APPENDIX 4

Code Sheet for Clausal Informational Units

|It was up in a ^{B}space station|and(uh)they ^{B}had a canary for a pet.| One day the ^{B}canary got lost./(And uh, looked ... and uh ...) he ^{A}looked for her¦and ^{E}that.| And he came ^{B}back with her on his hand|and ^{B}he thought| that it ^{B}was dead.| And then he gave ^{B}her some oxygen|and she ^{A}came back to life again.| And then she ^{B}passed out again.| And, then ...(um)... he ^{B}realized|that(um)it ^{B}wasn't just|that ^{B}she was sick.| It ^{A}was something wrong with the air.| And then he just ^{D}gave her more oxygen|and she came back to ^{A}life again.| (And)... and then they ^{D}went to see|what ^{B}was wrong with it.| And then ^{B}they fixed it. |Then it was ^{B}all right again.|

A = 4 (text specific information)

B = 14 (text entailed information)

D = 2 (text erroneous information)

E = 1 (text external information)

/ / = clausal boundary

/_________/ = incomplete clausal unit

(/ /) = clausal unit within the boundaries of a second clause

( ) = hesitation or pause -- um, ah, repetition of words

(_________) = correction/edit

¦ = compound subject or verb which counted as two units